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jc868 U.S. PTO
10/03/00

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
UTILITY PATENT APPLICATION TRANSMITTAL LETTER

Atty./Agent Docket No.: IND10200C01

Mailing Date: 10/03/00

Express Mail Label No.: EL034004770US

jc825 U.S. PTO
09/678529
10/03/00

Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

Dear Sir:

Transmitted herewith for filing under 37 CFR 1.53 (b) is a Nonprovisional Utility Patent Application:
____New Application; or

_X_ Continuation; or ______Divisional, or _______ Continuation-in-Part (CIP) Application of prior US application No.09/225,265, filed on 01/05/99, having US Examiner S. Bhattacharya, in Group Art Unit 2745: of

Inventor(s): Vega, et al.

For (Title): WIRELESS ELECTROSTATIC CHARGING AND COMMUNICATING SYSTEM

This transmittal letter has __2__ total pages.

Enclosed are:

_X_ 16 sheets of drawings, along with 51 pages of specification, claims, and abstract. Copies from Parent Application.

_X_ Oath or Declaration Combined with Power of Attorney (3 pages)
- ______ Newly Executed (original or copy)
- __X__ Copy from a prior application (if this is a Continuation/Division with no new matter)
  - ____Statement deleting named inventor(s) in prior application if this is a Continuation/Division (See 37 CFR 1.63(d)(2) and 1.33(b).)
  - ____Consider as the above Statement, Please delete as inventors for this application the following inventors named in the prior application: ________________

_____ Foreign priority to __________________ Patent application having serial number _____, and a filing date of______________ is hereby claimed under 35 USC 119.
______ A copy of the priority document is included herewith.

______ An Assignment Transmittal Letter and Assignment of the invention to MOTOROLA, INC.

_X_ An Information Disclosure Statement (IDS), with PTO-1449. Copies available upon request.

_X_ Print EFS Inventor Information Sheet(s).

_X_ Return Receipt Postcard

_X_ Preliminary Amendment

_____ Please cancel filed claims ____.

_X_ Incorporation by Reference (for Continuation/Division application) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being

part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

X Since the present application is based on a prior US application, please amend the specification by adding the following sentence before the first sentence of the specification: "The present application is based on prior US application No. 09/225,265, filed on 01/05/99, which is hereby incorporated by reference, and priority thereto for common subject matter is hereby claimed."

X The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CANCELED BY AMENDMENT

	NUMBER OF CLAIMS	NUMBER EXTRA	RATE	FEE
TOTAL CLAIMS	18- 20 =	0	X $18	= $.00
INDEPENDENT CLAIMS	4- 3 =	1	X $80	=$ 80.00
MULTIPLE DEPENDENT CLAIMS			$270	= $ 0.00
			BASIC FEE	=$ 710.00
			TOTAL FILING FEE	=$790.00

____ Applicant hereby petitions pursuant to 37 C.F.R. §1.136(a) for a __________ month extension of time for response to the outstanding Official Action mailed __________. The period for response was previously set to elapse __________, and is accordingly hereby extended to __________, which is still within the six-month statutory period for response (35 U.S.C. § 133) which elapses __________. The reason for this petition is that a Division, Continuation, or CIP is being filed, and it is desired to maintain the present application in pending condition pursuant to 35 USC § 120 through at least the filing of the Division, Continuation, or CIP application. The required Extension Fee established by 37 CFR § 1.17(a) pursuant to 35 U.S.C. § 41(a) (8) is:

		RATE	FEE
	First Month	$110.00	
	Second Month	$390.00	
	Third Month	$890.00	
	Fourth Month	$1,390.00	
	Fifth Month	$1,890.00	

X Please charge Deposit Account No. 13-4772 in the amount of $790.00 for the Total Filing Fee, and the Extension Fee under 37 C.F.R. §1.136(a), if applicable.

X The Commissioner is hereby authorized to charge any additional fees which may be required now or in the future under 37 CFR 1.16 or 37 CFR 1.17, including any present or future time extension fees which may be required, or credit any overpayment to Deposit Account No. 13-4772

X One additional copy of this sheet is enclosed

Please forward all correspondence to:

Customer Number **22917**

By: [signature]

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Date of Deposit October 3, 2000

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Tammy A. Olson

Name of person mailing paper or fee

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Signature Date

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CORRESPONDENCE INFORMATION

Correspondence Customer Number:: 22917

APPLICATION INFORMATION

Title Line One:: WIRELESS ELECTROSTATIC CHARGING AND COMM
Title Line Two:: UNICATING SYSTEM
Total Drawing Sheets:: 16
Formal Drawings?:: Yes
Application Type:: Utility
Docket Number:: IND10200C01
Secrecy Order in Parent Appl.?:: No

REPRESENTATIVE INFORMATION

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Tammy A. Olson
Name of person mailing paper or fee
Tammy A. Olson 10-3-00

UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS:	Vega et al.	EXAMINER:	Bhattacharya, S.
SERIAL NO.:	TBD	ART UNIT:	2745
FILED:	10/03/00	DOCKET NO.:	IND10200CO1
TITLED:	Wireless Electrostatic Charging and Communicating System		

Motorola, Inc.
Corporate Offices
1303 E. Algonquin Road
Schaumburg, Illinois 60196
October 3, 2000

PRELIMINARY AMENDMENT

Assistant Commissioner of Patents

Washington, DC 20231

Dear Sir:

In the Claims:

2. (Once Amended) The wireless electrostatic rechargeable device of claim 1, wherein the energy storage means is selected from a group consisting of: a rechargeable battery, and a capacitor.

Please cancel claim 3 without prejudice or disclaimer.

5. (Once Amended) The wireless electrostatic rechargeable device of claim 4, wherein the energy storage means is selected from a group consisting of: a rechargeable battery, and a capacitor.

Please cancel claims 6 and 8 without prejudice or disclaimer.

11. (Once Amended) The wireless electrostatic rechargeable device of claim 4, wherein the electrostatic charge receiver comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

[whereby] wherein at least one of the first electrostatic electrode and the second electrostatic electrode receive the electrostatic charge.

12. (Once Amended) The wireless electrostatic rechargeable device of claim 11, wherein the rectifier is selected from a group consisting of: a full-wave rectifier, and a half-wave rectifier.

Please cancel claims 13-31 without prejudice or disclaimer.

32. (Once Amended) The wireless electrostatic rechargeable device of claim 4, wherein the charge controller is selected from a group consisting of: a non-controllable type charge controller, and a variable type charge controller.

Please cancel claims 33-41 and 44-53 without prejudice or disclaimer.

54. (Once Amended) The [wireless electrostatic/electromagnetic charging and communicating system] rechargeable device of claim [53] 65, wherein the [transceiver] rechargeable device is selected from a group consisting of: an electrostatic [transceiver] rechargeable device having [and the charge receiver is an electrostatic charge receiver], a electromagnetic rechargeable device, and a combination electrostatic/electromagnetic rechargeable device.

Please cancel claims 55-64 without prejudice or disclaimer.

65. (Once Amended) [A wireless electrostatic charging system, comprising:

an electrostatic charger comprising:

an electrostatic electrode, for transmitting an excitation signal;

an exciter coupled to the electrostatic electrode, generating the excitation signal with a variable voltage;

and

an] A [electrostatic] rechargeable device, comprising:

an energy storage means with a capacity to store energy to operate the [electrostatic] rechargeable device;

a[n electrostatic] charge receiver, for receiving [the] an excitation signal and converting it into an AC signal;

a rectifier, coupled to the [electrostatic] charge receiver, for receiving the AC signal and providing a DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing a DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the [electrostatic] rechargeable device may be electrically charged by the excitation signal;

whereby the [electrostatic] charger may recharge the electrostatic rechargeable device.

12. (Once Amended) The wireless electrostatic rechargeable device of claim 11, wherein the rectifier is <u>selected from a group consisting of:</u> a full-wave rectifier<u>, and a half-wave rectifier</u>.

Please cancel claims 13-31 without prejudice or disclaimer.

32. (Once Amended) The wireless electrostatic rechargeable device of claim 4, wherein the charge controller is <u>selected from a group consisting of:</u> a non-controllable type charge controller<u>, and a variable type charge controller</u>.

Please cancel claims 33-41 and 44-53 without prejudice or disclaimer.

54. (Once Amended) The [wireless electrostatic/electromagnetic charging and communicating system] <u>rechargeable device</u> of claim [53] <u>65</u>, wherein the [transceiver] <u>rechargeable device</u> is <u>selected from a group consisting of:</u> an electrostatic [transceiver] <u>rechargeable device having</u> [and the charge receiver is an electrostatic charge receiver]<u>, a electromagnetic rechargeable device, and a combination electrostatic/electromagnetic rechargeable device</u>.

Please cancel claims 55-64 without prejudice or disclaimer.

65. (Once Amended) [A wireless electrostatic charging system, comprising:
an electrostatic charger comprising:
an electrostatic electrode, for transmitting an excitation signal;
an exciter coupled to the electrostatic electrode, generating the excitation signal with a variable voltage;
and
an] <u>A</u> [electrostatic] rechargeable device, comprising:
an energy storage means with a capacity to store energy to operate the [electrostatic] rechargeable device;
a[n electrostatic] charge receiver, for receiving [the] <u>an</u> excitation signal and converting it into an AC signal;
a rectifier, coupled to the [electrostatic] charge receiver, for receiving the AC signal and providing a DC signal;
a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing a DC voltage; and
a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,
whereby the [electrostatic] rechargeable device may be electrically charged by the excitation signal;
whereby the [electrostatic] charger may recharge the electrostatic rechargeable device.

66. (Once Amended) The rechargeable device [wireless electrostatic charging system] of claim 65 wherein the energy storage means [of the electrostatic rechargeable device] is selected from a group consisting of: a rechargeable battery, and a capacitor.

Please cancel claim 67 without prejudice or disclaimer.

68. (Once Amended) The [wireless electrostatic charging system] rechargeable device of claim 65, wherein the [electrostatic] charge receiver [of the electrostatic rechargeable device] comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

[whereby] wherein at least one of the first electrostatic electrode and the second electrostatic electrode receive an electrostatic charge.

69. (Once Amended) A method for charging a rechargeable device, comprising the steps of:

[(a) generating] receiving an electrostatic signal;

[(b) transmitting the electrostatic signal into a medium;]

[(c) receiving the electrostatic signal from the medium and] providing a first AC signal;

[(d)] rectifying the first AC signal into a DC signal;

[(e)] regulating the DC signal to provide a DC voltage; and

[(f)] charging an energy storage means responsive to the DC voltage.

Please cancel claims 70-73 without prejudice or disclaimer.

74. (Once Amended) The method of claim 69 for charging a[n] rechargeable device, the steps further comprising:

[(h) generating] receiving an electromagnetic signal;

[(i) transmitting the electromagnetic signal into a medium;] and

[(j) receiving the electromagnetic signal from the medium and] providing a second AC signal.

Please cancel claims 75-78 without prejudice or disclaimer.

In summary, for the foregoing reasons, reconsideration is respectfully requested and allowance of the claims is earnestly solicited. In the event that the Examiner has any questions regarding this amendment in particular or this application in general, the Examiner is urged to contact the Applicants' undersigned representative at the below-listed telephone number.

No Petition for Extension of Time is believed to be necessary for filing of the preliminary amendment. If an extension of time is deemed to be necessary, however, such extension is

hereby petitioned. The Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment, to Deposit Account No. 13-4772.

Respectfully submitted,

By: Terri S. Hughes

Terri S. Hughes
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"Express Mail" EL034004770US

Date of Deposit October 3, 2000

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Tammy A. Olson

Name of person mailing paper or fee

Tammy A. Olson 10-3-00

Date

"Express Mail" EL034004770US
Date of Deposit October 3, 2000

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Tammy A. Olson
Name of person mailing paper or fee
Tammy A. Olson 10-3-00
Signature Date

WIRELESS ELECTROSTATIC CHARGING AND COMMUNICATING SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation in part of a prior United States patent application Serial No. 09/061,146, filed 16 April 1998 by inventors Ted Geiszler et al, Attorney Docket No. IND00701P01, entitled "REMOTELY POWERED ELECTRONIC TAG WITH PLURAL ELECTROSTATIC ANTENNAS AND ASSOCIATED EXCITER/READER AND RELATED METHOD; RADIO FREQUENCY IDENTIFICATION TAG SYSTEM USING TAGS ARRANGED FOR COUPLING TO GROUND; RADIO FREQUENCY IDENTIFICATION TAG ARRANGED FOR MAGNETICALLY STORING TAG STATE INFORMATION; AND RADIO FREQUENCY IDENTIFICATION TAG WITH A PROGRAMMABLE CIRCUIT STATE" and assigned to Motorola, Inc. the disclosure of which prior application is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States provisional patent application Serial No. (), filed 11 September 1998 by Victor Vega and John Rolin, Attorney Docket No. IND10203, entitled "ELECTROSTATIC RFID/EAS SYSTEM" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States provisional patent application Serial No. (), filed 11 September 1998 by Victor Vega, Attorney Docket No. IND10173, entitled "CONTACTLESS ELECTROSTATIC RADIO FREQUENCY IDENTIFICATION PROGRAMMABILITY" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and

with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States provisional patent application Serial No. (), filed 11 September 1998 by Victor Vega, Attorney Docket No. IND10184, entitled "BODY TOUCH RFID SYSTEM" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States patent application Serial No. (), filed on an even date herewith by Victor Vega, Attorney Docket No. IND10201, entitled "ACTIVE ELECTROSTATIC TRANSCEIVER AND COMMUNICATING SYSTEM" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States provisional patent application Serial No. (), filed 11 September 1998 by Victor Vega, Attorney Docket No. IND10187, entitled "PIEZOELECTRIC CRYSTAL USED FOR DETECTION OF RFID/EAS TAGS" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States provisional patent application Serial No. (), filed 11 September 1998 by Victor Vega, John Hattick and Charles Zimnicki, Attorney Docket No. IND10188, entitled "GENERATION OF ELECTROSTATIC VOLTAGE POTENTIALS FOR RFID/EAS USING PIEZOELECTRIC CRYSTALS" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

Additionally, this application is related to United States patent application No. 09/151,418, filed 11 September 1998 by Victor Vega, Attorney Docket No. IND10185, entitled "A CONTACTLESS CAPACITIVE DATA TRANSMISSION SYSTEM AND METHOD" which is to be commonly assigned to Motorola, Inc. the disclosure of which is hereby

incorporated by reference, verbatim and with the same effect as though it were fully and completely set forth herein.

FIELD OF THE INVENTION

This invention relates to contactless battery charging systems and wireless communication systems. Particularly the present invention relates to systems for charging and communicating with rechargeable RFID transceivers and smart cards.

BACKGROUND OF THE INVENTION

Battery charging systems are not new. They are used to recharge batteries in many products used today including an automobile, a cordless telephone or cell phone, flashlights, calculators, portable computers, portable stereos, and may be used to directly recharge batteries themselves. Most of these charging systems require some sort of wire connection or physical contact with electrodes in order to recharge a battery.

Inductive or electromagnetic charging systems were introduced in order to charge systems without requiring a physical electrical connection. These were introduced for example in charging a battery in an electric tooth brush or batteries in electric automobiles. These electromagnetic charging systems eliminated the use of physical contacts or electrodes. This avoided the wear on physical contacts or electrodes normally associated with the numerous times a device would be recharged. Additionally the systems were more user friendly in that the devices were easier to recharge. The charging system for an automobile or tooth brush is an inductive or electromagnetic charging system having coils to transmit an electromagnetic field from the battery charger and receive the electromagnetic field in order to generate current within the device being charged. Coils for transmitting and receiving a charge tend to be large and cumbersome making it very difficult to integrate the charging components into a very small area. Previously space was not a large problem because previous battery charged devices, such as the tooth brush and automobile, have sufficient space for the relatively large charging components. Additionally, prior battery charged devices have

required large capacity storage and efficient battery charging systems and often times included a magnetic core to increase charging efficiency. A magnetic core added to an inductive charging systems makes it more difficult to integrate a charging system into a very small area.

Today there are systems where it is desirable to manufacture rechargeable active devices at high volumes and low costs thereby increasing the utility and avoiding the early disposal of low cost active devices. An example of these are smart cards where information about a card holder or a card holder's accounts or finances may be stored. To inexpensively manufacture rechargeable active devices such as these, it is desirable to reduce the size of the energy storage components and use less expensive components that may have relatively low storage capacity. Additionally, it is desirable to extend the life of rechargeable active devices by providing smaller energy storage components and eliminating physical contact mechanisms ordinarily used in battery charging systems.

BRIEF SUMMARY OF THE INVENTION

In a first embodiment, the present invention includes an electrostatic system for charging or communicating with an electrostatic rechargeable device or transceiver such as a smart card or radio frequency identification (RFID) card without requiring physical contact to electrodes. The electrostatic system may include an electrostatic reader, an electrostatic charger, an electrostatic programmer or encoder, and an electrostatic transceiver or other electrostatic rechargeable device. The electrostatic rechargeable device or transceiver has components, including a charge receiver and an energy storage means, for being charged by an electrostatic system. The energy storage means may be any energy storage device including a rechargeable battery or capacitor. In a second embodiment, a combination electrostatic/electromagnetic reader is provided so that an active electromagnetic transceiver or an active electrostatic transceiver may have its energy storage means charged. In a third embodiment, the electrostatic rechargeable device or transceiver has components, including an electrostatic charge receiver, an electromagnetic charge receiver and an energy storage device, such

that it may be alternatively charged by an electrostatic system or an electromagnetic system for compatibility in either system. In a fourth embodiment, the rechargeable transceiver includes a power manager to automatically select a power source to power the rechargeable transceiver such that it can operate passively or actively.

It is an object of the present invention to charge an electrostatic rechargeable device without physical contact by an electrostatic charger, an electrostatic reader or an electrostatic programmer/encoder.

It is another object of the present invention to optionally charge an electrostatic rechargeable device without physical contact by an electrostatic charger or an electrostatic/electromagnetic charger or electrostatic/electromagnetic reader.

Another object of the present invention is to provide an electrostatic rechargeable device that can be charged by either an electromagnetic communication system or an electrostatic communication system without physical contact.

A still further object of the present invention is to increase the life of a rechargeable electrostatic rechargeable device.

A still further object of the present invention is to decrease the size of the components within a rechargeable system.

Another object of the present invention is to lower the cost of manufacturing of an electrostatic rechargeable device such as a smart card.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a system level diagram of a typical electrostatic system and the combined electrostatic/electromagnetic system of the present invention.

FIG. 2A is a block diagram of the electrostatic reader of FIG. 1.

FIG. 2B is a block diagram illustrating the theory of operation of a Monopole electrostatic system.

FIG. 3 is a block diagram of the electrostatic transceiver of FIG. 1.

FIG. 4 is a block diagram the charging circuitry of a first embodiment for the electrostatic transceiver of FIG. 3.

FIG. 5A is a circuit schematic of exemplary components of the electrostatic charge receiver, rectifier, and voltage regulator blocks of FIG. 4.

FIG. 5B is a circuit schematic of alternate components for the rectifier block of FIG. 4.

FIG. 5C is a circuit schematic of alternate components for the voltage regulator of FIG. 4.

FIG. 5D is an exemplary waveform diagram illustrating the functionality of components of the rectifier and voltage regulator.

FIG. 6A is a circuit schematic of exemplary components for the charge controller and energy storage blocks of FIG. 4.

FIG. 6B is a circuit schematic of alternate exemplary components for the charge controller and energy storage blocks of FIG. 4.

FIG. 7 is a system level diagram illustrating the mixed electrostatic and electromagnetic system of the present invention.

FIG. 8A is a block diagram of the charging circuitry of a second embodiment of the present invention.

FIG. 8B is a block diagram of an alternate electrostatic/electromagnetic transceiver for the second embodiment of the present invention.

FIG. 9 is a circuit schematic of exemplary components for the electromagnetic charge receiver, rectifier and energy storage blocks of FIG. 8A.

FIG. 10 is a block diagram of the power manager of FIG. 4 and FIG. 8A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one skilled in the art that the present invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the present invention.

The present invention includes a method and apparatus for providing electrostatic ("ES") charging, as well as electrostatic communication, and utilizes capacitance-based technology. Electrostatic charging and communicating is accomplished through capacitive coupling which requires no physical contact or wires between a charger and a rechargeable device being charged or a reader and an electrostatic transceiver. The voltage applied to the capacitively coupled plates is an AC voltage generated by an electric field (i.e. an electrostatic field is developed) as opposed to an electromagnetic ("EM") field in order for a charge or signal to be communicated in the electrostatic charging and communicating system. In short, an electrostatic field is an energy (electrical) field created between two electrodes having a voltage differential. The wireless electrostatic rechargeable device needs to be in the proximity of the charger in order to have sufficient capacitive coupling to receive a charge or signal. A charger can also be an electrostatic reader so that it can not only electrostatically charge a rechargeable device but it can electrostatically communicate with the rechargeable device through the capacitive coupling. Additionally, the components for the electrostatic charging can include additional electromagnetic components so that both electrostatic and electromagnetic charging and communicating can occur.

FIG. 1 illustrates the preferred embodiment of the electrostatic communication and charging system 100 which includes electrostatic reader 101, wireless electrostatic rechargeable transceiver 102, host computer system 103 and electrostatic charger 104. Transceivers may also be referred to as transponders or tags. Additionally, FIG. 1 illustrates a second preferred embodiment of the combined

electrostatic/electromagnetic communication and charging system 120 which includes the components of the electrostatic communication and charging system 100 and an electrostatic/electromagnetic reader 121, a host computer system 123, an electromagnetic transceiver 124, and an electromagnetic charger 126. It can be appreciated that the invention also encompasses a charging system which includes an electrostatic charger such as charger 104 and any electrostatic rechargeable device having an electrostatic charge receiver and a charge storage capability such as electrostatic transceiver 102. Electrostatic transceiver 102 can transmit and receive information to/from the electrostatic reader 101 or electrostatic/electromagnetic reader 121. Additionally electrostatic transceiver 102 can be charged and re-charged by the electrostatic reader 101, the electrostatic/electromagnetic reader 121 or the electrostatic charger 104. The electrostatic reader 101 and the electrostatic charger 104 each have electrostatic charge transmitters while the electrostatic/electromagnetic reader 121 has a combined electrostatic/electromagnetic charge transmitters. Electromagnetic charger 126 has electromagnetic charge transmitters only. The electrostatic active device or electrostatic transceiver has electrostatic charge receivers while the electromagnetic transceiver has electromagnetic charge receivers and a combined electrostatic/electromagnetic reader 121 has both electrostatic charge receivers and electromagnetic charge receivers. Each of the electrostatic charge receivers and charge transmitters for the respective electrostatic transceiver 102, electrostatic reader 101, and electrostatic charger 104 include electrostatic electrodes which may also be referred to as antenna, capacitor plates, contactless electrodes, wireless electrodes or isolation electrodes. These electrostatic electrodes provide for the antenna, contactless, wireless and the somewhat isolated functionality of the electrostatic system which requires no physical contact between the electrodes in order to charge or communicate. The electrostatic transceiver 102 has at least two electrostatic electrodes which will be referred to herein as electrostatic electrode 112 and electrostatic electrode 113 and simultaneously operate as antenna for communications and electrostatic charge receivers for receiving

electrostatic charges. The electrostatic electrodes 105 and 106 of electrostatic reader 101 will be referred to herein as electrostatic electrode 105 and electrostatic electrode 106 and simultaneously operate as antenna for communications and electrostatic charge transmitters for transmitting electrostatic charges. Transceiver circuitry can be implemented in an integrated circuit. The electrostatic electrodes and associated electrical circuits of a wireless electrostatic system can be implemented on flat surfaces including paper, plastic, or synthetic substrates. Moreover, the manufacturing process involved is inexpensive and requires minimal components and set-up. In the preferred application of a smart card or RFID card, the electrostatic electrodes 112 and 113 are conducting plates separated from one another such as illustrated in FIG. 1.

Electrostatic electrodes 112 and 113 are one part of the capacitive plates for capacitive coupling in order to receive electrostatic charges and communications. The other part of the capacitive plates are provided by the electrostatic reader 101, electrostatic/electromagnetic reader 121, or the electrostatic charger 104. The space between the coupled electrostatic electrodes defines the dielectric medium between the two parts of the capacitive plates. The capacitive plates of the reader or charger can be in either a monopole or a dipole configuration. In a monopole configuration, only one set of coupling plates is used. Earth ground acts as a low impedance return path. The electrostatic transceiver may couple to earth ground through a human body or other relatively low impedance that couples to one or the other of the electrostatic electrodes.

Referring to FIG. 2A, electrostatic reader 101 is in a monopole configuration with an electrostatic electrode 107 coupled to earth ground with or without an electrostatic plate. As shown in FIG. 2A, electrostatic reader 101 comprises exciter 201, receiver 202, demodulator 203, processor 204, exciter electrostatic electrode 105, receiver electrostatic electrode 106, and the earth ground connection 107. Referring to FIG. 2B, the theory of operation of a monopole electrostatic system is now explained where the electrostatic transceiver couples to earth ground through a human body. A human body 205 couples to the transceiver

102 through the electrostatic electrode 112. The human body 205 couples to earth ground 107 through the capacitance 210 representing a shoe or other insulating materials between the human body 205 and the ground. Additionally there is a ground resistance 211 that varies as the distance of the human body 205 varies from the reader 101. Between electrostatic electrode 113 and electrostatic electrode 106 there is a return capacitance 212 and between electrostatic electrode 113 and electrostatic electrode 105 there is a excitation capacitance 213. Between the ground connection for the receiver 202 and the exciter 201 there is an input resistance 215. Between electrostatic electrode 112 and electrostatic electrode 113 there is circuitry within the transceiver 102 that causes impedance 216 to vary periodically with time. The return current path is through the impedance of the human body 205, the capacitance 210, and resistance 211 to earth ground node 107. The excitation signal generated by the exciter has an AC voltage of Ve and electrostatically couples through capacitance 213 to the transceiver 102 causing a voltage Vtag to be present between the transceiver 102 and earth ground 107. The reader 101 can communicate to the transceiver 102 by using various modulation techniques with the excitation signal generated by the exciter 201. A current, Ie, is caused to flow in the return current path. If the transceiver 102 desires to communicate information to the reader 101, it performs load modulation whereby the impedance 216 is caused to vary and a portion of the energy of the excitation signal is reflected back from electrostatic electrode 113 and through capacitance 212 to electrostatic electrode 106. As impedance 216 varies, the voltage Vtag varies accordingly. In order for the reflection of energy back to the electrostatic electrode 106 to occur effectively, the reactance of the capacitance 213 and the reactance of capacitance 212 must each be greater than the sum of the ground resistance 211, the reactance of ground capacitance 210 and the impedance of the human body. This typically occurs when the transceiver is brought within the capacitive coupling range (i.e. read range) of a reader. The reflected energy received by the reader 101 causes a voltage of Vr to be present between the input to the receiver 202 and earth ground 107. The voltage Vr causes a current to flow, Ir, through the capacitance 212 and the input

resistor 215. Thus, the current through the exciter and through the capacitance 213 is the sum of the currents Ie and Ir. In this manner the monopole configuration allows for bi-directional communication between the transceiver 102 and the reader 101.

In FIG. 1, the electrostatic charger 104 is in a dipole configuration having electrostatic electrode 108 and electrostatic electrode 109. In the dipole configuration neither electrostatic electrode has a preferential coupling path to earth ground. The dipole configuration lends itself to a more portable system such as a charger 104 but one could easily couple an electrode to a ground reference of some sort thereby having a portable monopole system. The impedance (real and imaginary) of the coupled electrodes can be either an AC (capacitive) or DC (resistive) path.

In general, electrostatic reader 101 generates an electrostatic (electrical) field for use both as a power source for electrostatic transceiver 102 and for transferring information between electrostatic reader 101 and electrostatic transceiver 102. As such, electrostatic reader 101 electrostatically generates and transmits an excitation signal to the surrounding air, gas, atmosphere or non-electrically conductive medium via the reader's electrostatic electrodes, except for the return path in a monopole system. The excitation signal is an AC signal which activates electrostatic transceiver 102 when it is comes within the capacitive coupling range of reader 101. Upon being sufficiently energized, electrostatic transceiver 102 may respond by electrostatically reflecting or transmitting a read data signal carrying the information stored in its memory to electrostatic reader 101 (as part of a read operation). In accordance to the present invention, reader 101 may also electrostatically couple a write signal to communicate and write information to the electrostatic transceiver 102 (as part of a write operation). Alternatively, such programming or charging can be carried out by a separate programming or encoding unit (not illustrated) or the electrostatic charger 104. It is to be appreciated that the excitation signal must be generated and transmitted by electrostatic reader 101 to charge the electrostatic transceiver 102. The excitation signal is an AC energy source and can be a continuous waveform or a varying waveform (i.e.

amplitude, frequency, time, etc. of the waveform may vary). Alternatively a user could manually cause the electrostatic reader 101 or a charger 104 to generate the excitation signal to charge or communicate with the electrostatic transceiver 102 by selecting a button or switch. The reader 101 usually has available a larger power source than the electrostatic transceiver 102. Thus, the reader 101 can have very sensitive receiving circuitry and high energy transmission capability when compared with the electrostatic transceiver 102.

The read signal received by electrostatic reader 101 is demodulated, amplified, and filtered. The data carried by the read signal is decoded and formatted as required prior to being transferred to host computer system 103. Upon receiving the formatted data, host computer system 103 may use the data to update a database or perform other processing. Host computer system 103 may further processes the information received as required in certain applications. For example, in an access RFID application, host computer system 103 may compare the information received with those already stored in its database to determine whether access should be granted or denied to the individual. Alternatively, charging status information of a transceiver may be transmitted to the reader indicating that charging is complete or incomplete so that a reader can send such information to a host or perform local operations. In which case either the reader or the transceiver could have an indicator instructing a user that charging is complete or incomplete and that charging needs to occur soon at a charger or a reader that supports charging.

Referring now to FIG. 2A illustrating in greater detail the components of electrostatic reader 101 in a monopole configuration. As shown in FIG. 2A, electrostatic reader 101 comprises exciter 201, receiver 202, demodulator 203, processor 204, exciter electrostatic electrode 105, receiver electrostatic electrode 106, and the earth ground connection 107. Exciter electrostatic electrode 105 is connected to exciter 201 and receiver electrostatic electrode 106 is connected to receiver 202. In a read operation, exciter 201 generates an excitation signal for activating electrostatic transceiver 102. Basically, the excitation signal generated by the exciter 201 provides the electrostatic charges or

energy to the electrostatic transceiver 102. In addition, the carrier frequency of the excitation signal may provide clock information for transceiver 102. Alternatively an internal clock may be generated by the transceiver 102. In the preferred embodiment, the excitation signal has a carrier frequency of 125 kHz. The excitation signal is transmitted to transceiver 102 through exciter electrode 105 and the ground connection 107. Additionally, exciter 201 may further generate and transmit an signal having data information by modulating data onto a carrier of the signal. The signal may carry a read or write mode data sequence including instruction, data, and address information related to a read operation or write operation for a transceiver 102 that is within the range of the reader 101. In response to a read operation, transceiver 102 communicates data, which may be memory data or other data within the electrostatic transceiver 102, to the reader 101. In response to a write operation, transceiver 102 reads data that is transmitted by the reader 101 or other source such as a programmer, decodes the data and stores it in memory within the electrostatic transceiver 102 or processes the data to perform other functions within the electrostatic transceiver 102.

When the reader 101 is receiving signals, the receiver 202 amplifies and filters out unwanted frequencies and allows desired frequencies to pass. These desired frequencies are then provided to the demodulator 203 to demodulate and to decode signals at the carrier frequency in order to detect information being transmitted by the electrostatic transceiver 102. In the preferred embodiment electrostatic transceiver 102 modulates the data onto the carrier using Binary Phase Shift Keying (BPSK), a form of Phase Shift Keying (PSK), and encodes data using NRZ encoding for communication from the transceiver 102 to the reader 101. It is to be appreciated that other modulation schemes such as Amplitude Modulation (AM), Frequency Shift Keying (FSK) modulation, and others can also be used to modulate the read data signal. Other encoding schemes, such as Manchester encoding, may be used as well. Data that is decoded is provided to the processor 204 for pre-processing and formatting for use by the host computer 103.

When the reader 101 is in a write operation for transmitting write data signals, data from host computer 103 is provided to processor 204

for reformatting into write data that may be transmitted and understood by the transceiver 102. The write data for transmission is then provided to exciter 201 which controls the generation of the excitation signal. By controlling the generation of the excitation signal, the write data may be modulated onto the carrier frequency of the excitation signal. Such modulation is performed to carry the command and control instructions (e.g., operation codes, lock bit, etc.), data, and memory address information into a write mode or read mode data sequence of an signal which allows transceiver 102 distinguish whether a write operation or read operation is desired by reader 101. As a result, the write mode data sequence includes instruction, data, and address information related to a write or functional operation. In short, exciter 202 generates and transmits a write data signal carrying a write mode data sequence at a predetermined time following the generation and transmission of the excitation signal.

A read mode data sequence can be similarly generated by the reader 101 and cause the electrostatic transceiver 102, programmed to wait for the read mode data sequence, to transmit a read signal for reception by the reader 101. Alternatively, the transceiver 102 may be programmed to automatically transmit a read signal when within the read range of a reader 101. In the preferred embodiment, Amplitude Shift Keying (ASK) modulation is performed by the reader 101 for communication to the transceiver 102 by modulating the excitation signal.

Reference is now made to FIG. 3 illustrating in greater detail the components of transceiver 102. As shown in FIG. 3, transceiver 102 includes an integrated circuit 300 having an analog interface module 301, a bitrate generator 303, a write decoder 304, a charge pump 305, an input register 306, a controller 307, a mode register 308, a modulator 309, a memory 310, a charge receiver, and electrostatic electrodes 112 and 113. As previously discussed, electrostatic electrodes 112 and 113 receive electrostatic signals from the reader 101 or the charger 104 and couple electrostatic signals back to the reader 101 or charger 104. Electrostatic electrode 112 and electrostatic electrode 113 are connected to the analog interface module 301 and the modulator 309. In this manner signals received or communicated by the transceiver 102 pass

through the analog interface module 301 or the modulator 309. For optimum electrostatic performance, it is desirable to keep the input capacitance measured between electrostatic electrodes 112 and 113 as small as possible.

Controller 307 controls the functionality of the transceiver 102 in conjunction with the analog interface module 301. Controller 307 couples to nearly all components of the electrostatic transceiver 102 except for the electrostatic electrodes and pads. Memory 310 may be a volatile memory requiring a constant supply of energy or a non-volatile memory such as an EEPROM memory that retains its information when power is no longer supplied. In the case of EEPROM memory, the charge pump 305 may be required in order to boost the power supply voltage in order to write data into the EEPROM memory. Input register 306 temporarily stores information that is to be written into memory 310. It may need to store the information due to a delay in the write cycle caused by the charge pump 305 or other reasons. In any case, storing data into the input register 306 allows the controller 307 to process other information for the transceiver 102. Mode register 308 reads configuration information for the electrostatic transceiver 102 from memory 310 and provides this to the controller 307. Write decoder 304 analyzes a data sequence being received by the electrostatic transceiver 102 and determines whether the transceiver should go into a write mode or whether it needs to remain in a receive mode or read mode. Modulator 309 prepares data read from memory 310 for transmission by the electrostatic transceiver 102. Modulator 309 encodes and load modulates the data read from memory 310.

When in proximity of a reader 101 or charger 104, the transceiver first receives the excitation signal. The excitation signal is generated by reader 101 at a carrier frequency. After receiving the capacitively coupled excitation signal, the electrostatic transceiver 102 derives a square wave at the carrier frequency, which is then used as a reference clock signal for the transceiver. In this manner of generating a clock signal, information received by the electrostatic transceiver 102 is synchronized with the clock signal. This alleviates generating a clock with a clock oscillator and

synchronizing the data and clock using phase-locked loop techniques, although an internal oscillator could be employed if desired.

The analog interface module 301 performs multiple functions when receiving and communicating electrostatic signals and charges in an analog signal form. The analog interface module 301 generally performs the electrostatic communication and power supply management functions for the electrostatic transceiver 102. Additionally, it performs clock extraction in order to provide a clock to other components of the electrostatic transceiver 102 including the bitrate generator 303 such that the clock is synchronized with received data. The analog interface module 301 also demodulates a received signal to generate a received data stream. A gap detector (not shown) within the analog interface module 301 analyzes the data stream and determines if a write operation may be involved. If so, it forwards the data sequence signal to the write decoder 304. Write decoder 304 then decodes the data sequence signal to retrieve instruction, data, and address information related to the write operation. If it recognizes the codes as a write command, write decoder 304 signals to so notify controller 307. Write decoder 304 also verifies the validity of the data stream. The decoded instructions and information about the validity of the data stream are provided to controller 307.

Bitrate generator 303 receives as input the clock signal which was extracted by the clock extraction circuit (not shown). The clock signal preferably has a carrier frequency of 125 kHz. Bitrate generator 303 generates the data transfer rate at which data is transferred from/to memory 310 during a read or write mode, respectively. Bitrate generator 303 generates the data transfer rate by dividing the carrier frequency by a predetermined factor. The data transfer rate is provided to controller 307. In the preferred embodiment, bitrate generator 303 can be programmed to operate at either one-eighth, one-sixteenth or one-thirty-second of the carrier frequency.

FIG. 4 illustrates a simplified block diagram of the electrostatic charging system including the electrostatic charger 104 and the electrostatic transceiver 102. FIG. 4 emphasizes a charge receiver 402 and portions of the analog interface module 301 of the electrostatic

transceiver 102. The charging circuitry of the analog interface module 301 includes a rectifier 404, a voltage regulator 406, a charge controller 408, an energy storage means 410, and a power manager 412. The energy storage means 410 can be a rechargeable battery, a capacitor, or some other type of energy storing component. Preferably the energy storage means 410 is a thin battery for use in a smart card or RFID transceiver that is inexpensive and may have a relatively low storage capacity. The rectifier 404 receives an AC signal having an AC voltage from the charge receiver 402 and rectifies it into a DC signal. Voltage regulator 406 receives the DC signal from the rectifier 404 and limits it to a DC voltage range. The voltage regulator is designed so that the range of DC voltage generated is sufficiently great enough to charge the energy storage means 410. Charge controller 408 receives the DC voltage from the voltage regulator 406 and controls the charging of the energy storage means 410. The charge controller 408 may simply cause charging to occur when there is sufficient voltage from the voltage regulator and avoid the discharge of the energy storage means 410 when there is insufficient voltage being received from the voltage regulator 406. Charge controller 408 may have more complex control mechanisms such as monitoring the charge condition of the energy storage means and making a determination whether or not to charge based on the charge condition. Charge controller 408 may also regulate the amount of current flow into the energy storage means 410 and prevent the reverse flow of current back into the voltage regulator 406 when receiving insufficient voltage levels for charging thereby preventing degradation of the energy storage means 410. Energy storage means 410 supplies a low level supply voltage ("LSV") 450 to other circuitry within the analog interface module 301 and the electrostatic transceiver 102. Energy storage means 410 may supply the high level supply voltage ("HSV") 451 to a power manager 412 or the components within the electrostatic transceiver 102. Power manager 412 may perform a power on reset function for the remaining components of the electrostatic transceiver 102. Additionally it may perform energy conservation functionality by only powering certain parts of the electrostatic transceiver 102 at appropriate moments. Also, it may select between power sources. For example, in one case it may

select the energy storage means 410 when sufficiently charged and in another case it may select the output from the voltage regulator, bypassing the energy storage means 410 when insufficiently charged or when its no longer usable, when the transceiver 102 is in an excitation field. Additionally, the power manager 412 may delay the power up of components of the electrostatic transceiver 102 until the energy storage means 410 is sufficiently charged or sufficient power is otherwise available. In any case, the power manager 412 may supply power to other circuitry of the transceiver 102 over the device power line 460.

FIG. 5A is a schematic diagram of exemplary circuitry for the charge receiver 402, the rectifier 404A, and the voltage regulator 406A. The exemplary charge receiver 402 includes two electrostatic electrodes 112 and 113 which also function as antenna for transceiving information to or from the electrostatic reader 101. The two electrostatic electrodes have sufficient area in order to receive a charge from an electrostatic charger 104 or an electrostatic reader 101. Electrostatic electrode 112 is connected to node 505 and electrostatic electrode 113 is connected to node 506. The exemplary rectifier 404A is a full-wave bridge rectifier and includes diodes 501-504 in a configuration such that the AC voltage at nodes 505 and 506 is converted into a DC supply voltage having a full-wave rectified waveform at node 510 with respect to node 450. Diodes 503 and 504 have their anodes connected to LSV 450. The cathode of diode 503 and anode of diode 501 are connected to node 506. The cathode of diode 504 and the anode of diode 502 are connected to node 505. The cathodes of diodes 501 and 502 are connected to node 510. In FIG. 5B, alternate full-wave rectifiers 404B-404E are illustrated. Half-synchronous full-wave bridge rectifier 404B includes PFET transistors 513 and 514 and diodes 515 and 516. Half-synchronous full-wave bridge rectifier 404C includes diodes 517 and 518 and NFET transistors 519 and 520. Synchronous full-wave bridge rectifier 404D includes NFET transistors 521-524. Synchronous full-wave bridge rectifier 404E includes PFET transistors 525-528. A simpler half-wave rectifier may be used as illustrated in FIG. 5B by rectifiers 404F-404J but may be less efficient in rectification than that of the full-wave rectifiers. Half-wave rectifier 404F includes the diode 530. Half-wave rectifier 404G includes

an NPN bipolar transistor 531 with its base tied to its collector while half-wave rectifier 404H includes a PNP bipolar transistor 532 with its base tied to its collector. Half-wave rectifier 404I includes an NFET with its gate coupled to its drain and input 505 of the rectifier with its source coupled to the output 510 of the rectifier. Half-wave rectifier 404J includes a PFET with its gate coupled to its drain and output 510 of the rectifier with its source coupled to the input 505 of the rectifier. The exemplary voltage regulator 406A is a shunt voltage regulator and includes capacitor 511 and zener diode 512 for filtering out any AC components. Capacitor 511 may be selected to be sufficiently large enough to reduce ripple in the DC voltage on node 510. One end of capacitor 511 is connected to node 510 and the other end is connected to the LSV 450. Zener diode 512 is selected such that, when operating in its reverse biased mode, it sufficiently limits the maximum voltage on node 510. The cathode of zener diode 512 is connected to node 510 and its anode is connected to LSV 450. The voltage regulator 406 may use other common components, such as a transistor, in order to integrate the circuitry of the active device into one integrated circuit chip. Alternate shunt voltage regulators 406B-406E as illustrated in FIG. 5C may be used for voltage regulation. Shunt voltage regulator 406B includes the capacitor 511 and NFET transistors 530-533 all coupled in series and having their gates coupled in a diode configuration (gate coupled to the drain). Shunt voltage regulator 406C includes the capacitor 511 and PFET transistors 534-537 all coupled in series and having their gates coupled in a diode configuration (gate coupled to the drain). Shunt voltage regulator 406D includes the capacitor 511 and NFET transistors 538-542 coupled in series and in a diode configuration and NPN bipolar transistors 543 and 544 connected in a Darlington configuration as illustrated. Shunt voltage regulator 406E includes the capacitor 511 and PFET transistors 546-550 coupled in series and in a diode configuration and PNP bipolar transistors 551 and 552 connected in a Darlington configuration as illustrated. Either field effect transistor (FET) type, NFETS or PFETS, in the series path within the shunt voltage regulators may be added or subtracted in order to increase or decrease the voltage limitation of the regulator. Additionally the Darlington pairs of PNP 551-552 and NPN

543-544 may be a single bipolar transistor or multiple bipolar transistor each in a Darlington configuration.

As an alternative to shunt voltage regulators, series-pass voltage regulators 406F-406I as illustrated in FIG. 5C may be used for voltage regulation. In regulators 406F-406I, the node 510 is split in two into nodes 510A and 510B in order to insert the transistors 566-569 between 510A and 510B. Nodes 510 and 510B may also be referred to as a DC supply node. In regulator 406F, PFET 566 has its source coupled to node 510A, its drain coupled to node 510B, and its gate coupled to the output 562 of the voltage controller 560. The voltage controller 560 is an error amplifier and properly generates a signal on output 562 to control the transistors 566-569. Voltage controller 560 compares a voltage reference input 561 and a feedback voltage from node 510B in order to properly regulate the voltage at node 510B. In regulator 406G, NFET 567 has its drain coupled to node 510A, its source coupled to node 510B, and its gate coupled to the output 562 of the voltage controller 560. In regulator 406H, PNP transistor 568 has its emitter coupled to node 510A, its collector coupled to node 510B, and its base coupled to the output 562 of the voltage controller 560. In regulator 406I, NPN transistor 569 has its collector coupled to node 510A, its emitter coupled to node 510B, and its base coupled to the output 562 of the voltage controller 560. Regulators 406F-406I operate similarly in that they control the conduction of transistors 566-569, and therefore the voltage dropped across nodes 510A and 510B, such that the voltage at node 510B is regulated to the desired value.

FIG. 5D illustrates exemplary waveforms showing the functionality of the rectifier and voltage regulator components. In each plot voltage is plotted against time. The voltage regulation is set to the maximum voltage level VREG 570. Waveforms 571-574 depict the voltage on node 510 versus time. Waveforms 571-574 have a single polarity due to the rectification provided by the rectifier. Waveforms 571 and 572 are illustrations of the voltage on node 510 versus time with the capacitor 511 eliminated from the voltage regulator. Waveforms 573-574 are illustrations of the voltage on node 510 versus time with the capacitor 511. As illustrated, capacitor 511 reduces the ripple voltage in the

waveform. Waveforms 571 and 573 depict receiving electrostatic signals that are insufficient to cause the voltage regulator to limit the voltage level to VREG 570. Waveforms 572 and 573 depict receiving electrostatic signals that cause the voltage regulator to limit the voltage level to VREG 570.

FIG. 6A is a schematic diagram of exemplary circuitry for the charge controller 408 and the energy storage means 410. The exemplary charge controller 408A is a non-controllable type charge controller and includes a diode 602 and a resistor 603. The anode of diode 602 is connected to node 510. The cathode of diode 602 is connected to a first end of resistor 603. Resistor 603 has a second end connected to HSV 451. In this exemplary charge controller 408A, the diode 602 prevents the reverse flow of current from the energy storage means 410 and requires that the voltage generated by the voltage regulator be greater than the voltage of the energy storage means by at least the turn on threshold of the diode 602. Resistor 603 is appropriately selected in accordance with the characteristics of the energy storage means so that excessive current is not provided to the energy storage means during charging. Alternate non-controllable type charge controllers 408B and 408C are illustrated in FIG. 6A and operate similar to charge controller 408A. Charge controller 408B includes the diode 602 and a PFET transistor 604 in a resistor configuration with its gate tied to the low level voltage supply 450. Charge controller 408C includes the diode 602 and an NFET transistor 605 in a resistor configuration with its gate tied to a high voltage source, in this case its own drain. Also the charge controller 408 may be a variable type charge controller 408D-408G as illustrated in FIG. 6B with a variable control means such as current controller 615. A variable type charge controller may be used to control the charge rate, reduce battery memory phenomena of rechargeable batteries, or perform other charge control functions. Generally, the charge control is tailored to the characteristics of the energy storage means and limits the maximum current flow including completely shutting off current flow to the battery. Current controller 615 is an error amplifier that compares a reference input 618 with the feedback received from the high level supply voltage 451. Depending upon the amount of error the resistance of transistors

606-609 are varied by the proper control signal generated on output 617 from the current controller 615. Referring to FIG. 6B, the variable charge controller 408D includes the current controller 615, a diode 602 and a PFET transistor 606 with its gate tied to a variable voltage source 617 received from the current controller 615. Variable charge controller 408E includes the current controller 615, the diode 602 and an NFET transistor 607 with its gate tied to a variable voltage source 617 received from the current controller 615. Variable charge controller 408F includes the current controller 615, the diode 602 and a PNP bipolar transistor 607 with its base tied to a variable current source 617 received from the current controller 615. Variable charge controller 408G includes the current controller 615, the diode 602 and an NPN bipolar transistor 609 with its base tied to a variable current source 617 received from the current controller 615. While diode 602 has been described as being consistent with the charge controllers 408D-408G, diode 602 is not always necessary and may be eliminated in some cases. The exemplary energy storage means 410A is a rechargeable battery 610. The positive terminal of the rechargeable battery 610 is connected to HSV 451. The negative terminal of the rechargeable battery 610 is connected to LSV 450. In the case of smart cards or RFID transceivers, the rechargeable battery preferably is a thin rechargeable battery and may have a nominal voltage of around 3 volts between LSV 450 and HSV 451 in order to provide power to an integrated circuit chip. Alternatively, the energy storage means 410B includes a capacitor 611 for holding charge. Referring to FIG. 4, power manager 412 can receive the HSV 451 provided by the energy storage means 410 and appropriately power the remaining components within the electrostatic transceiver 102 over the device power line 460 in a manner consistent with the desired design of power control and management within the electrostatic transceiver 102.

FIG. 7 illustrates a second embodiment of the present invention of an electrostatic and electromagnetic charging system 700 which can simultaneously charge the energy storage means and communicate information by means of inductive coupling or capacitive coupling. The electrostatic and electromagnetic charging system 700 may include the electrostatic reader 101, host computer system 103, electromagnetic

reader 701, electromagnetic reader 721, a host computer system 703, and an electrostatic/electromagnetic transceiver 702. While both electromagnetic reader 701 and electromagnetic reader 721 are illustrated in FIG. 7 both are not required in system 700. Electromagnetic reader 701 illustrates a reader having separate coils for receiving and transmitting while electromagnetic reader 721 illustrates a lower cost reader having a single coil for receiving and transmitting electromagnetic signals. The electromagnetic reader 701 and electromagnetic reader 721 are similar in functionality to the electrostatic reader 101 however they couple to active devices such as electrostatic/electromagnetic transceiver 702 by means of electromagnetic coupling. In order to couple electromagnetically, electromagnetic reader 701 uses a first electromagnetic coil 705 and a second electromagnetic coil 706 to respectively transmit or receive an electromagnetic signal by means of an AC electromagnetic field. Electromagnetic reader 721 uses an electromagnetic coil 725 to respectively transmit or receive an electromagnetic signal by means of electromagnetic radio waves. Electromagnetic reader 701 includes an exciter 711, a receiver 712, a demodulator 713, and processor 714. Processor 714 of the electromagnetic reader 701 includes a host interface for communicating with the host computer system 703. Electromagnetic reader 721 includes an exciter 731, a receiver 732, a demodulator 733, and processor 734. Processor 734 of the electromagnetic reader 721 includes a host interface for communicating with the host computer system 723. The electromagnetic reader 701 and electromagnetic reader 721 operate functionally similar to the electrostatic reader 101 described above. While the exciter in the electrostatic reader 101 generates a first excitation signal, the exciter 711 generates a second excitation signal for transmission as an electromagnetic radio wave to excite and charge the electrostatic/electromagnetic transceiver 702. Electrostatic/electromagnetic transceiver 702 includes coil 715 and capacitor 716, a parallel resonant circuit, in order to electromagnetically couple to the coils 705 and 706 of the electromagnetic reader 701. Electrostatic/electromagnetic transceiver 702 includes electrostatic electrode 112 and 113 for interfacing and capacitively coupling to the

electrostatic reader 101. Electrostatic/electromagnetic transceiver 702 operates functionally similar to the electrostatic transceiver 102 described above.

FIG. 8A illustrates a block diagram of the second embodiment of the electrostatic charging system including the electrostatic/electromagnetic transceiver 702 and an electromagnetic charger 804. FIG. 8A emphasizes a charge receiver 802 and portions of the analog interface module 301 of the electrostatic/electromagnetic transceiver 702. The charging circuitry of the analog interface module 301 includes functionally similar circuits as described above including the rectifier 404, a voltage regulator 406, a charge controller 408, an energy storage means 410, and a power manager 412. The description and functionality of the components of electrostatic/electromagnetic transceiver 702 are similar to those components of electrostatic transceiver 102 having the same reference designators, except that, rectifier 404 rectifies an AC voltage received from the charge receiver 802 instead of charge receiver 402. The AC voltage received is rectified into a DC signal by the rectifier 404 and supplied to the voltage regulator 406. Electromagnetic charger 804 includes exciter 801 and coil 803. Exciter 801 operates similar to exciter 201 and exciter 711. Exciter 801 and exciter 711 are designed for driving coils 803 and 705 respectively.

FIG. 8B is a block diagram of an alternate electrostatic/electromagnetic transceiver 810 for the second embodiment of the present invention. The electrostatic/electromagnetic transceiver 810 includes a transceiver circuit 812, an electromagnetic charge receiver 814, the electrostatic charge receiver 402, and the energy storage means 410. Like numbered components previously described function similarly in the ES/EM transceiver 810. Electromagnetic charge receiver 814 includes the parallel resonant circuit of the coil 715 and the capacitor 716. The electrostatic/electromagnetic transceiver 810 is optimized by keeping the electromagnetic and electrostatic circuitry separated but combined in the transceiver 810 so that any adverse affects that might otherwise occur if the circuitry were combined is reduced. In transceiver circuit 812, certain circuitry is duplicated in order to interface to the electrostatic charge receiver 402 and the

electromagnetic charge receiver 814. Rectifier 404 is duplicated as rectifier 404X and rectifier 404Y. Voltage regulator 406 is duplicated as voltage regulator 406X and voltage regulator 406Y. While dual voltage regulators may be employed as illustrated, it is preferable to use a single voltage regulator 406 in order to conserve circuitry. In this case, the outputs of the rectifier 404X and rectifier 404Y are summed together and provided to a single voltage regulator 406. Load modulator 309 is duplicated as load modulator 309X and load modulator 309Y. A clock extractor within the analog interface module is duplicated as clock extractor 818X and clock extractor 818Y. A demodulator within the analog interface module is duplicated as demodulator 820X and 820Y. Other circuitry of the transceiver circuit 812 is shared by the circuitry dedicated to supporting either electrostatic signals or electromagnetic signals. Signals to the shared circuitry from either block may be multiplexed such as by multiplexer 822 or summed together such as may be performed by charge controller 408. Alternatively, charge controller 408 may select the preferred source of energy from either the regulator 406X or the regulator 406Y available respectively from nodes 510X and 510Y. Similarly power manager may now select power from three sources, the regulator 406X, the regulator 406Y, or the energy storage means 410. In order to communicate signals to either an electrostatic reader or an electromagnetic reader, transceiver circuit 812 includes a data encoder 816, a modulator 309X for communicating through the electrostatic electrodes 112 and 113, and a modulator 309Y for communicating through the electromagnetic coil 715. To receive electrostatic signals, transceiver circuit 812 includes a clock extractor 818X and a demodulator 820X. To receive electromagnetic signals, transceiver circuit 812 includes a clock extractor 818Y and a demodulator 820Y. Alternatively a single demodulator may be used that is clocked by clock extractor 818X and clock extractor 818Y to decode electrostatic and electromagnetic signals respectively. Received data signals from the demodulators can be multiplexed by multiplexer 822 for storage into memory 310 or they may be multiplexed into other circuitry. Controller 307 controls the interfacing to the two signal types.

FIG. 9 is a schematic diagram of exemplary circuitry for the charge receiver 802, the rectifier 404, and the voltage regulator 406. Rectifier 404 and voltage regulator 406 function similarly as described above. The exemplary charge receiver 802 includes an electrostatic charge receiver and an electromagnetic charge receiver. The exemplary electrostatic charge receiver consists of two electrostatic electrodes 112 and 113, which may also act as antenna for transceiving information to or from the electrostatic reader 101 or an electrostatic programmer. The exemplary electromagnetic charge receiver consists of coil 715 and resonant capacitor 716. The electrostatic electrodes 112 and 113 are preferably of higher conductivity to avoid interference with the electromagnetic coil 715. To improve the communication of signals from the transceiver 702, the modulator 309 may be coupled to an additional coil and resonant capacitor (not shown) instead of coil 715 and capacitor 716 for transmission of electromagnetic signals. In the charge receiver 802, electrostatic electrode 112 is connected to node 905, electrostatic electrode 113 is connected to node 906, and coil 715 has one end connected to node 905 and an opposite end connected to node 906. Exemplary rectifier 404 couples to an electrostatic/electromagnetic charge receiver 802 instead of an electrostatic charge receiver 402. Diodes 501-504 are connected in a bridge rectifier configuration such that the AC voltage at nodes 905 and 906 is converted into an oscillating variable DC supply voltage at node 510. Diodes 503 and 504 have their anodes connected to LSV 450. The cathode of diode 503 and anode of diode 501 are connected to node 906. The cathode of diode 504 and the anode of diode 502 are connected to node 905. The cathodes of diodes 501 and 502 are connected to node 510. The exemplary voltage regulator 406 is similarly configured and functions as previously described above.

FIG. 10 is a block diagram of the power manager 412 of FIG. 4 and FIG. 7. The power manager 412 includes a power on reset (POR) circuit 1002, a multiplexer 1004 and a power analyzer 1006. The POR circuit 1002 is coupled to the device power line 460 and causes a signal on line 1010 to enable other circuitry when the transceiver 102 or 702 has sufficient power supply voltage for proper operation. The multiplexer

1004 multiplexes the DC supply voltage on node 510 and the high level supply voltage 451 out onto the device power line 460. The multiplexer 1004 can simply consist of a pair of switching transistors 1008 and 1009, preferably P type Metal Oxide Semiconductor Field Effect Transistors with their drains connected together and their sources connected to the power supplies. Other switching mechanisms, such as fully complementary MOSFET switches, which may be efficient in switching power from one source to another can be utilized to perform a multiplexing function. The power analyzer provides the control signals 1018-1019 to control the multiplexer 1004. As illustrated in FIG. 10, the control signals 1018 and 1019 are connected respectively to the gates of switching transistors 1008 and 1009. The power analyzer 1006 receives the DC supply voltage on node 510, the high level supply voltage 451, and the low level supply voltage 450. The power analyzer 1006 may receive additional control signals such as the sleep signal 1020 in order to provide additional power supply control to the power supplied to the device power 460. For example, the sleep signal 1020, when active in a sleep mode, may disable multiplexer 1004 from supplying any power to the device power line 460. In this manner, selective portions of circuitry may be powered on while others remained powered off in a sleep mode. The power analyzer compares the voltage between the high level supply voltage 451 and the low level supply voltage 450 with the voltage between the DC supply voltage on node 510 and the low level supply voltage 450. The analysis performed by the power analyzer can be basic or more complicated. Basic analysis would comprise comparing the two voltages and selecting one based on a predetermined selection scheme. For example, if the voltage on node 510 is greater than the voltage on line 451 by more than one half volt, then the power analyzer would activate switch 1008 to selectively couple the DC supply voltage on node 510 to the device power line 460. More complicated analysis would analyze the quality of the power sources and analyze the performance of any energy storage means 610 that may be used in order to determine which power supply to use. Preferably the analysis would include determining if a battery were dead and could no longer be charged. In this case, the power analyzer 1006 and the multiplexer 1004 cause

transceiver 102 or 702 to be passive transceivers. That is, the transceiver 102 and 702 will still function but require being closer to a reader in order to power up and transmit any signals than would otherwise be necessary as compared to an active transceiver. In this manner the transceiver would function as a passive transceiver and would increase the useful life of an active transceiver if it ever were the case that a battery was low (i.e. required charging) or if the battery were to die or become non-rechargeable. Another complicated analysis the power analyzer 1006 may perform is to evaluate the number of times a rechargeable battery 610 has been recharged in order to more fully discharge a battery before recharging in order to avoid any memory effect in the rechargeable battery.

The present invention has many advantages over the prior art. The present invention provides a charging system without requiring physical contact with a charger. One advantage of the present invention is that it provides a wireless charging system that does not use expensive or bulky coils. Another advantage is that the present invention decreases the size of the charging components which increases the length of utility of a portable wireless device and allows a smaller device size. A still further advantage is that the present invention provides the capability of using lower cost components and thereby decreases the cost of manufacturing electrostatic rechargeable devices or electrostatic transceivers such as smart cards. Another advantage is that a third embodiment of the present invention is backward compatible so that it can be charged by an electrostatic system or an electromagnetic system. Another advantage is that a fourth embodiment of the rechargeable transceiver includes a power manager that can selectively choose to use power from an energy storage means or passive components excited by an electrostatic or electromagnetic field such that it can operate passively or actively.

The preferred embodiment of the present invention is thus described. While the present invention has been described in particular embodiments, the present invention should not be construed as limited by such embodiments, but rather construed according to the claims below.

What is claimed is:

CLAIMS

1. A wireless electrostatic rechargeable device for being electrically charged by an electrostatic charge, the wireless electrostatic rechargeable device comprising:

an energy storage means with a capacity to store energy to operate the wireless electrostatic rechargeable device;

an electrostatic charge receiver, for receiving an electrostatic charge and converting it into an AC signal; and

a rectifier, coupled to the electrostatic charge receiver and the energy storage means, for receiving the AC signal and providing a DC signal and for storing energy in the energy storage means,

whereby the wireless electrostatic rechargeable device may be electrically charged by the electrostatic charge.

2. The wireless electrostatic rechargeable device of claim 1, wherein the energy storage means is a rechargeable battery.

3. The wireless electrostatic rechargeable device of claim 1, wherein the energy storage means is a capacitor.

4. A wireless electrostatic rechargeable device for being electrically charged by an electrostatic charge, the wireless electrostatic rechargeable device comprising:

an energy storage means with a capacity to store energy to operate the wireless electrostatic rechargeable device;

an electrostatic charge receiver, for receiving an electrostatic charge and converting it into a first AC signal;

a rectifier, coupled to the electrostatic charge receiver, for receiving the first AC signal and providing a DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and for regulating the DC signal to a DC voltage at a DC supply node; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the wireless electrostatic rechargeable device may be electrically charged by the electrostatic charge.

5. The wireless electrostatic rechargeable device of claim 4, wherein the energy storage means is a rechargeable battery.

6. The wireless electrostatic rechargeable device of claim 4, wherein the energy storage means is a capacitor.

7. The wireless electrostatic rechargeable device of claim 4, wherein the wireless electrostatic rechargeable device further comprises:

an electromagnetic charge receiver, for receiving an electromagnetic charge and converting it into a second AC signal.

8. The wireless electrostatic rechargeable device of claim 7, wherein the electromagnetic charge receiver comprises:

a coil coupled to the electrostatic charge receiver for receiving the electromagnetic charge and converting it into the second AC signal; whereby the rectifier receives the second AC signal and provides the DC signal.

9. The wireless electrostatic rechargeable device of claim 7, wherein the electromagnetic charge receiver comprises:

a coil for receiving the electromagnetic charge and converting it into the second AC signal.

10. The wireless electrostatic rechargeable device of claim 9, wherein the wireless electrostatic rechargeable device further comprises:

a second rectifier, coupled to the electromagnetic charge receiver, for receiving the second AC signal and providing the DC signal.

11. The wireless electrostatic rechargeable device of claim 4, wherein the electrostatic charge receiver comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive the electrostatic charge.

12. The wireless electrostatic rechargeable device of claim 11, wherein the rectifier is a full-wave rectifier.

13. The wireless electrostatic rechargeable device of claim 12, wherein the full-wave rectifier is a bridge rectifier comprising:

a first diode having a cathode coupled to the second electrostatic electrode and an anode coupled to a low level supply voltage;

a second diode having a cathode coupled to the first electrostatic electrode and an anode coupled to the low level supply voltage;

a third diode having a cathode coupled to the voltage regulator and an anode coupled to the second electrostatic electrode; and

a fourth diode having a cathode coupled to the voltage regulator and an anode coupled to the first electrostatic electrode,

whereby the first diode, the second diode, the third diode, and the fourth diode are for rectifying the first AC signal into the DC signal.

14. The wireless electrostatic rechargeable device of claim 12, wherein the full-wave rectifier is a bridge rectifier comprising:

a first PFET having a gate coupled to the second electrostatic electrode, a source coupled to the first electrostatic electrode and a drain coupled to the voltage regulator;

a second PFET having a gate coupled to the first electrostatic electrode, a source coupled to the second electrostatic electrode and a drain coupled to the voltage regulator;

a first diode having an anode coupled to a low level supply voltage and a cathode coupled to the second electrostatic electrode; and

a second diode having an anode coupled to the low level supply voltage and a cathode coupled to the first electrostatic electrode,

whereby the first PFET, the second PFET, the first diode, and the second diode are for rectifying the first AC signal into the DC signal.

15. The wireless electrostatic rechargeable device of claim 12, wherein the full-wave rectifier is a bridge rectifier comprising:

a first NFET having a gate coupled to the second electrostatic electrode, a drain coupled to the first electrostatic electrode and a source coupled to a low level supply voltage;

a second NFET having a gate coupled to the first electrostatic electrode, a drain coupled to the second electrostatic electrode and a source coupled to the low level supply voltage;

a first diode having an anode coupled to a first electrostatic electrode and a cathode coupled to the voltage regulator; and

a second diode having an anode coupled to a second electrostatic electrode and a cathode coupled to voltage regulator,

whereby the first NFET, the second NFET, the first diode, and the second diode are for rectifying the first AC signal into the DC signal.

16. The wireless electrostatic rechargeable device of claim 12, wherein the full-wave rectifier is a bridge rectifier comprising:

a first PFET having a gate coupled to the second electrostatic electrode, a source coupled to the first electrostatic electrode and a drain coupled to the voltage regulator;

a second PFET having a gate coupled to the first electrostatic electrode, a source coupled to the second electrostatic electrode and a drain coupled to the voltage regulator;

a third PFET having a gate coupled to the first electrostatic electrode, a source coupled to the first electrostatic electrode, and a drain coupled to a low level supply voltage; and

a fourth PFET having a gate coupled to the second electrostatic electrode, a source coupled to the second electrostatic electrode, and a drain coupled to the low level supply voltage,

whereby the first PFET, the second PFET, the third PFET, and the fourth PFET are for rectifying the first AC signal into the DC signal.

17. The wireless electrostatic rechargeable device of claim 12, wherein the full-wave rectifier is a bridge rectifier comprising:

a first NFET having a gate coupled to the first electrostatic electrode, a drain coupled to the first electrostatic electrode and a source coupled to the voltage regulator;

a second NFET having a gate coupled to the second electrostatic electrode, a drain coupled to the second electrostatic electrode and a source coupled to the voltage regulator;

a third NFET having a gate coupled to the second electrostatic electrode, a drain coupled to the first electrostatic electrode, and a source coupled to a low level supply voltage; and

a fourth NFET having a gate coupled to the first electrostatic electrode, a drain coupled to the second electrostatic electrode, and a source coupled to the low level supply voltage,

whereby the first NFET, the second NFET, the third NFET, and the fourth NFET are for rectifying the first AC signal into the DC signal.

18. The wireless electrostatic rechargeable device of claim 11, wherein the rectifier is a half-wave rectifier.

19. The wireless electrostatic rechargeable device of claim 4, wherein the voltage regulator is a shunt voltage regulator.

20. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to the DC supply node and another end coupled to a low level supply voltage;

a plurality of field effect transistors coupled in series and each in a diode configuration, having a source of a first field effect transistor coupled to the DC supply node and a gate and drain of a second field effect transistor coupled to the low level supply voltage; and

a PNP bipolar transistor, having a base coupled to the drain of the first field effect transistor, an emitter coupled to the DC supply node, and a collector coupled to the low level supply voltage.

21. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to the DC supply node and another end coupled to a low level supply voltage;

a plurality of field effect transistors, coupled in series and each in a diode configuration, having a drain and gate of a first field effect transistor coupled to the DC supply node and a source of a second field effect transistor coupled to the low level supply voltage; and

an NPN bipolar transistor, having a base coupled to the drain of the second field effect transistor, an emitter coupled to the low level supply voltage, and a collector coupled to the DC supply node.

22. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to the DC supply node and another end coupled to a low level supply voltage;

a plurality of field effect transistors, coupled in series and each in a diode configuration, having a drain and gate of a first field effect transistor coupled to the DC supply node and a source of a second field effect transistor coupled to the low level supply voltage; and

a plurality of NPN bipolar transistors in a Darlington configuration, having a base of a first NPN bipolar transistor coupled to a drain of the second field effect transistor, a collector of the first NPN bipolar transistor coupled to the DC supply node, a collector of a second NPN bipolar transistor coupled to the DC supply node, and an emitter of the second NPN bipolar transistor coupled to the low level supply voltage.

23. The wireless electrostatic rechargeable device of claim 22, wherein the plurality of field effect transistors and the plurality of NPN bipolar transistors comprises:

a first NFET having a gate and drain coupled together to the DC supply node and a source coupled at a first source;

a second NFET having a gate and a drain coupled together to the first source and a source coupled at a second source;

a third NFET having a gate and a drain coupled together to the second source and a source coupled at a third source;

a fourth NFET having a drain and a gate coupled together to the third source and a source coupled at a fourth source;

a first NPN bipolar transistor having a collector coupled to the DC supply node, a base coupled to the fourth source, and a first emitter;

a second NPN bipolar transistor having a collector coupled to the DC supply node, a base coupled to the first emitter, and an emitter coupled to the low level supply voltage; and

a fifth NFET having a drain and a gate coupled together to the fourth source and a source coupled to the low level supply voltage.

24. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to the DC supply node and another end coupled to a low level supply voltage;

a plurality of field effect transistors coupled in series and each in a diode configuration, having a source of a first field effect transistor coupled to the DC supply node and a gate and drain of a second field effect transistor coupled to the low level supply voltage; and

a plurality of PNP bipolar transistors in a Darlington configuration, having a base of a first PNP bipolar transistor coupled to the drain of the first field effect transistor, a collector of the first PNP bipolar transistor coupled to the low level supply voltage, a collector of a second PNP bipolar transistor coupled to the low level supply voltage, and an emitter of the second PNP bipolar transistor coupled to the DC supply node.

25. The wireless electrostatic rechargeable device of claim 24, wherein the plurality of field effect transistors and the plurality of PNP bipolar transistors comprises:

a first PFET having a source coupled to the DC supply node and a gate and drain coupled together at a first drain;

a first PNP bipolar transistor having a collector coupled to the low level supply voltage, a base coupled to the first drain, and a first emitter;

a second PNP bipolar transistor having a collector coupled to the low level supply voltage, a base coupled to the first emitter, and an emitter coupled to the DC supply node;

a second PFET having a source coupled to the first drain and a gate and a drain coupled together at a second drain;

a third PFET having a source coupled to the second drain and a gate and a drain coupled together at a third drain;

a fourth PFET having a source coupled together to the third drain and a gate and a drain coupled together at a fourth drain; and

a fifth PFET having a source coupled to the fourth drain and a gate and a drain coupled together at the low level supply voltage.

26. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to the DC supply node and another end coupled to a low level supply voltage; and

a plurality of field effect transistors coupled in series to the DC supply node and the low level supply voltage and each coupled in a diode configuration.

27. The wireless electrostatic rechargeable device of claim 26, wherein the plurality of field effect transistors comprises:

a first NFET having a drain and a gate coupled together to the DC supply node and a first source;

a second NFET having a drain and a gate coupled together to the first source and a second source;

a third NFET having a drain and a gate coupled together to the second source and a third source; and

a fourth NFET having a drain and a gate coupled together to the third source and a source coupled to the low level supply voltage.

28. The wireless electrostatic rechargeable device of claim 26, wherein the plurality of field effect transistors comprises:

a first PFET having a first source coupled to the DC supply node and a drain and a gate coupled together at a first drain;

a second PFET having a source coupled to the first drain and a drain and a gate coupled together at a second drain;

a third PFET having a source coupled to the second drain and a drain and a gate coupled together at a third drain; and

a fourth PFET having a source coupled to the third drain and a drain and a gate coupled together to the low level supply voltage.

29. The wireless electrostatic rechargeable device of claim 19, wherein the shunt voltage regulator comprises:

a capacitor, having one end coupled to a DC supply from the rectifier and an opposite end coupled to a low level supply voltage; and

a zener diode, having an anode coupled to the low level supply voltage and a cathode coupled to the DC supply node,

whereby the capacitor and the zener diode are for regulating the DC supply, for filtering out any AC components and for providing the DC voltage.

30. The wireless electrostatic rechargeable device of claim 4, wherein the voltage regulator is a series-pass voltage regulator.

31. The wireless electrostatic rechargeable device of claim 30, wherein the series-pass voltage regulator comprises:

a controller, for comparing a reference input with the DC voltage to generate a control signal; and

a transistor, coupled to the controller, the rectifier, and the charge controller, for regulating the DC voltage provided to the charge controller in response to the control signal.

32. The wireless electrostatic rechargeable device of claim 4, wherein the charge controller is a non-controllable type charge controller.

33. The wireless electrostatic rechargeable device of claim 32, wherein the non-controllable type charge controller comprises:

a diode, having an anode coupled to the DC supply node; and

a resistor, having a first end coupled to a cathode of the diode and a second end coupled to the energy storage means

whereby the diode and the resistor cause energy to be stored in the energy storage means when the DC voltage is provided by the voltage regulator and prevents degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator.

34. The wireless electrostatic rechargeable device of claim 32, wherein the non-controllable type charge controller comprises:

a diode, having an anode coupled to the DC supply node; and

a PFET, having a source coupled to a cathode of the diode, a gate coupled to a low level voltage supply, and a drain coupled to the energy storage means

whereby the diode and the PFET cause energy to be stored in the energy storage means when the DC voltage is provided by the voltage regulator and prevents degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator.

35. The wireless electrostatic rechargeable device of claim 34, wherein the energy storage means is a rechargeable battery.

36. The wireless electrostatic rechargeable device of claim 34, wherein the energy storage means is a capacitor.

37. The wireless electrostatic rechargeable device of claim 34, wherein the non-controllable type charge controller comprises:

a diode, having an anode coupled to the DC supply node; and

an NFET, having a gate and a drain coupled together to a cathode of the diode, and a source coupled to the energy storage means,

whereby the diode and the NFET cause energy to be stored in the energy storage means when the DC voltage is provided by the voltage

regulator and prevents degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator.

38. The wireless electrostatic rechargeable device of claim 4 wherein the charge controller is a variable type charge controller.

39. The wireless electrostatic rechargeable device of claim 38 wherein the variable type charge controller comprises:

a diode, having an anode coupled to the DC supply node;

a controller, for comparing a reference input with the DC voltage to generate a control signal; and

a transistor, coupled to the controller, a cathode of the diode, and the energy storage means, for regulating a current provided to the energy storage means,

whereby the diode, the controller, and the transistor cause current to flow into the energy storage means when the DC voltage is provided by the voltage regulator and prevents degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator on the DC supply node.

40. The wireless electrostatic rechargeable device of claim 39, wherein the energy storage means is a rechargeable battery.

41. The wireless electrostatic rechargeable device of claim 39, wherein the energy storage means is a capacitor.

42. The wireless electrostatic rechargeable device of claim 4 further comprising:

a power manager, coupled to the voltage regulator and the energy storage means, for performing an analysis of the energy supplied by the voltage regulator and the energy storage means, and for selectively coupling the energy storage means or the voltage regulator to circuitry within the wireless electrostatic rechargeable device responsive to the analysis,

whereby the wireless electrostatic rechargeable device can operate with or without the energy storage means.

43. The wireless electrostatic rechargeable device of claim 42, wherein the power manager comprises:

a power analyzer, coupled to the voltage regulator and the energy storage means, for analyzing the energy supplied by the voltage regulator and the energy storage means and for generating a control signal; and

a multiplexer, coupled to the power analyzer, the voltage regulator, the energy storage means and circuitry within the wireless electrostatic rechargeable device, for receiving the energy supplied by the voltage regulator and the energy storage means, and for selectively coupling the energy supplied by the voltage regulator or the energy storage means to circuitry within the wireless electrostatic rechargeable device in response to the control signal.

44. The wireless electrostatic rechargeable device of claim 43, wherein the multiplexer comprises:

a first switch, coupled to the power analyzer, the voltage regulator, and circuitry within the wireless electrostatic rechargeable device, for receiving the energy supplied by the voltage regulator, and for selectively coupling the energy supplied by the voltage regulator to circuitry within the wireless electrostatic rechargeable device in response to the control signal; and

a second switch, coupled to the power analyzer, the energy storage means and circuitry within the wireless electrostatic rechargeable device, for receiving the energy supplied by the energy storage means, and for selectively coupling the energy supplied by the energy storage means to circuitry within the wireless electrostatic rechargeable device in response to the control signal.

45. The wireless electrostatic rechargeable device of claim 42, wherein the energy storage means is a rechargeable battery.

46. The wireless electrostatic rechargeable device of claim 42, wherein the energy storage means is a capacitor.

47. A wireless electrostatic charging and communicating system, comprising:

an electrostatic reader comprising:

a first electrostatic electrode, for transmitting a write data signal;

a second electrostatic electrode, for receiving a read signal;

a processor having an interface, transmitting information to and receiving information from a computer;

an exciter coupled to the first electrostatic electrode and the processor, generating an excitation signal, receiving information from the processor and modulating the excitation signal to transmit the write data signal through the first electrostatic electrode; and

a receiver coupled to the second electrostatic electrode, receiving the read signal from the second electrostatic electrode and causing the processor to process the read signal;

and

an electrostatic transceiver, comprising:

an energy storage means with a capacity to store energy to operate the electrostatic transceiver;

an electrostatic charge receiver, for receiving the excitation signal and converting it into an AC signal;

a rectifier, coupled to the electrostatic charge receiver, for receiving the AC signal and providing a DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing a DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the electrostatic transceiver may be electrically charged by the excitation signal,

whereby the electrostatic reader may electrostatically recharge and communicate with the electrostatic transceiver.

48. The wireless electrostatic charging and communicating system of claim 47, wherein the energy storage means of the electrostatic transceiver is a rechargeable battery.

49. The wireless electrostatic charging and communicating system of claim 47, wherein the energy storage means of the electrostatic transceiver is a capacitor.

50. The wireless electrostatic charging and communicating system of claim 47, wherein the electrostatic charge receiver of the electrostatic transceiver comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive an electrostatic charge.

51. The wireless electrostatic charging and communicating system of claim 47, wherein the electrostatic reader further comprises:

a third electrostatic electrode, coupled to the exciter, for transmitting the write data signal in a dipole configuration, whereby the exciter transmits the write data signal through the first electrostatic electrode and the third electrostatic electrode.

52. The wireless electrostatic charging and communicating system of claim 47, wherein the electrostatic reader further comprises:

a fourth electrostatic electrode, coupled to the receiver, for receiving the read signal in a dipole configuration, whereby the receiver receives the read signal from the second electrostatic electrode and the fourth electrostatic electrode.

53. A wireless electrostatic/electromagnetic charging and communicating system, comprising:

an electrostatic/electromagnetic reader comprising:

a first electrostatic electrode, for electrostatically transmitting signals;

a first electromagnetic coil, for electromagnetically transmitting signals;

a second electrostatic electrode, for electrostatically receiving signals;

a second electromagnetic coil, for electromagnetically receiving signals;

a processor having an interface, transmitting information to and receiving information from a computer;

an exciter coupled to the first electrostatic electrode, the first electromagnetic coil, and the processor, generating an excitation signal, receiving information from the processor and modulating the excitation signal to transmit signals through the first electrostatic electrode and the first electromagnetic coil; and

a receiver coupled to the second electrostatic electrode, the second electromagnetic coil and the processor, receiving signals from the second electrostatic electrode and the second electromagnetic coil and causing the processor to process the received signals; and

a transceiver, comprising:

an energy storage means having a capacity to store energy to operate the transceiver;

a charge receiver, for receiving the excitation signal and converting it into an AC signal;

a rectifier, coupled to the charge receiver, for receiving the AC signal and providing a DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing a DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing

degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the transceiver may be electrically charged by the excitation signal, and

whereby the electrostatic/electromagnetic reader may recharge and communicate with the transceiver.

54. The wireless electrostatic/electromagnetic charging and communicating system of claim 53, wherein the transceiver is an electrostatic transceiver and the charge receiver is an electrostatic charge receiver.

55. The wireless electrostatic/electromagnetic charging and communicating system of claim 54, wherein the electrostatic charge receiver comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive electrostatic charges.

56. The wireless electrostatic/electromagnetic charging and communicating system of claim 53, wherein the transceiver is an electromagnetic transceiver and the charge receiver is an electromagnetic charge receiver for receiving an electromagnetic charge and converting it into the AC signal.

57. The wireless electrostatic/electromagnetic charging and communicating system of claim 56, wherein the electromagnetic charge receiver comprises:

a coil for receiving the electromagnetic charge and converting it into the AC signal.

58. The wireless electrostatic/electromagnetic charging and communicating system of claim 53, wherein the energy storage means of the transceiver is a rechargeable battery.

59. The wireless electrostatic/electromagnetic charging and communicating system of claim 53, wherein the energy storage means of the transceiver is a capacitor.

60. A wireless electrostatic and electromagnetic charging and communicating system, comprising:

an electrostatic reader comprising:

a first electrostatic electrode, for transmitting a write data signal;

a second electrostatic electrode, for receiving a read signal;

a processor having an interface, transmitting information to and receiving information from a computer;

an exciter coupled to the first electrostatic electrode and the processor, generating a first excitation signal, receiving information from the processor and modulating the first excitation signal to transmit the write data signal through the first electrostatic electrode; and

a receiver coupled to the second electrostatic electrode and the processor, receiving the read signal from the second electrostatic electrode and causing the processor to process the read signal;

an electromagnetic reader comprising:

a first electromagnetic coil, for transmitting a write data signal;

a second electromagnetic coil, for receiving a read signal;

a processor having an interface, transmitting information to and receiving information from a computer;

an exciter, coupled to the first electromagnetic coil and the processor, generating a second excitation signal, receiving information from the processor and modulating the second excitation signal to transmit the write data signal through the first electromagnetic coil; and

a receiver, coupled to the second electromagnetic coil and the processor, receiving the read signal from the second electromagnetic coil and causing the processor to process the read signal; and

an electrostatic/electromagnetic transceiver, comprising:

an energy storage means having a capacity to store energy to operate the electrostatic/electromagnetic transceiver;

an electrostatic charge receiver, for receiving the first excitation signal and converting it into a first AC signal;

an electromagnetic charge receiver, for receiving the second excitation signal and converting it into a second AC signal;

a first rectifier, coupled to the electrostatic charge receiver, for receiving the first AC signal and providing a DC signal;

a second rectifier, coupled to the electromagnetic charge receiver, for receiving the second AC signal and providing the DC signal;

a voltage regulator, coupled to the first rectifier and the second rectifier, for receiving the DC signal and providing a DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the electrostatic/electromagnetic transceiver may be electrically charged by the first excitation signal or the second excitation signal, and

whereby the electrostatic reader may electrostatically recharge and communicate with the electrostatic/electromagnetic transceiver or the electromagnetic reader may electromagnetically recharge and communicate with the electrostatic/electromagnetic transceiver.

61. The wireless electrostatic and electromagnetic charging and communicating system of claim 60, wherein the energy storage means of the electrostatic/electromagnetic transceiver is a rechargeable battery.

62. The wireless electrostatic and electromagnetic charging and communicating system of claim 60, wherein the energy storage means of the electrostatic/electromagnetic transceiver is a capacitor.

63. The wireless electrostatic and electromagnetic charging and communicating system of claim 60, wherein the electrostatic charge receiver of the electrostatic/electromagnetic transceiver comprises:

a first electrostatic electrode, coupled to the first rectifier; and

a second electrostatic electrode, coupled to the first rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive an electrostatic charge.

64. The wireless electrostatic and electromagnetic charging and communicating system of claim 60, wherein the electromagnetic charge receiver of the electrostatic/electromagnetic transceiver comprises:

a coil, coupled to the second rectifier, for receiving an electromagnetic signal.

65. A wireless electrostatic charging system, comprising:

an electrostatic charger comprising:

an electrostatic electrode, for transmitting an excitation signal;

an exciter coupled to the electrostatic electrode, generating the excitation signal with a variable voltage;

and

an electrostatic rechargeable device, comprising:

an energy storage means with a capacity to store energy to operate the electrostatic rechargeable device;

an electrostatic charge receiver, for receiving the excitation signal and converting it into an AC signal;

a rectifier, coupled to the electrostatic charge receiver, for receiving the AC signal and providing a DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing a DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the electrostatic rechargeable device may be electrically charged by the excitation signal;

whereby the electrostatic charger may recharge the electrostatic rechargeable device.

66. The wireless electrostatic charging system of claim 65, wherein the energy storage means of the electrostatic rechargeable device is a rechargeable battery.

67. The wireless electrostatic charging system of claim 65, wherein the energy storage means of the electrostatic rechargeable device is a capacitor.

68. The wireless electrostatic charging system of claim 65, wherein the electrostatic charge receiver of the electrostatic rechargeable device comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive an electrostatic charge.

69. A method for charging a rechargeable device, comprising the steps of:

(a) generating an electrostatic signal;

(b) transmitting the electrostatic signal into a medium;

(c) receiving the electrostatic signal from the medium and providing a first AC signal;

(d) rectifying the first AC signal into a DC signal;

(e) regulating the DC signal to provide a DC voltage; and

(f) charging an energy storage means responsive to the DC voltage.

70. The method of claim 69 for charging a rechargeable device, wherein the energy storage means is a rechargeable battery.

71. The method of claim 69 for charging a rechargeable device, wherein the energy storage means is a capacitor.

72. The method of claim 69 for charging a rechargeable device, wherein the rechargeable device comprises:

the energy storage means with a capacity to store energy to operate the rechargeable device;

an electrostatic charge receiver, for receiving the electrostatic signal and converting it into the first AC signal;

a rectifier, coupled to the electrostatic charge receiver, for receiving the first AC signal and providing the DC signal;

a voltage regulator, coupled to the rectifier, for receiving the DC signal and providing the DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the rechargeable device may be electrically charged by the electrostatic signal.

73. The method of claim 72 for charging a rechargeable device, wherein the electrostatic charge receiver comprises:

a first electrostatic electrode, coupled to the rectifier; and

a second electrostatic electrode, coupled to the rectifier,

whereby the first electrostatic electrode and the second electrostatic electrode receive an electrostatic charge.

74. The method of claim 69 for charging an rechargeable device, the steps further comprising:

(h) generating an electromagnetic signal;

(i) transmitting the electromagnetic signal into a medium; and

(j) receiving the electromagnetic signal from the medium and providing a second AC signal.

75. The method of claim 74 for charging a rechargeable device, wherein the rechargeable device comprises:

the energy storage means having a capacity to store energy to operate the portable wireless rechargeable device;

an electrostatic charge receiver, for receiving the electrostatic signal and converting it into the first AC signal;

an electromagnetic charge receiver, for receiving the electromagnetic signal and converting it into the second AC signal;

a first rectifier, coupled to the electrostatic charge receiver, for receiving the first AC signal and providing the DC signal;

a second rectifier, coupled to the electromagnetic charge receiver, for receiving the second AC signal and providing the DC signal;

a voltage regulator, coupled to the first rectifier and the second rectifier, for receiving the DC signal and providing the DC voltage; and

a charge controller, coupled to the voltage regulator and the energy storage means, for storing energy in the energy storage means when the DC voltage is provided by the voltage regulator and preventing degradation of the energy storage means when the DC voltage is not sufficiently provided by the voltage regulator,

whereby the rechargeable device may be electrically charged by the electromagnetic signal or the electrostatic signal.

76. The method of claim 75 for charging a rechargeable device, wherein the electromagnetic charge receiver comprises:

a coil coupled to the electrostatic charge receiver for receiving the electromagnetic signal and converting it into the second AC signal.

77. The method of claim 75 for charging a rechargeable device, wherein the energy storage means is a rechargeable battery.

78. The method of claim 75 for charging a rechargeable device, wherein the energy storage means is a capacitor.

WIRELESS ELECTROSTATIC CHARGING AND COMMUNICATING SYSTEM

ABSTRACT OF THE DISCLOSURE

The wireless electrostatic charging and communicating system includes an electrostatic reader, an electrostatic charger and an electrostatic rechargeable device or electrostatic transceiver such as such as a smart card or radio frequency identification (RFID) card without requiring physical contact to electrodes. The electrostatic system is capacitance based and the charging and communicating occurs over capacitively coupled electrostatic electrodes or electrostatic electrodes. The electrostatic rechargeable device or transceiver includes a charge receiver and an energy storage means, for being charged or communicated with in the electrostatic system. The energy storage means may be any energy storage device including a rechargeable battery or capacitor. In a second embodiment, the electrostatic rechargeable device or transceiver includes an electrostatic charge receiver and an electromagnetic charge receiver with the energy storage means so that it may be alternatively charged or communicated with in an electrostatic system or an electromagnetic system for compatibility in either system.

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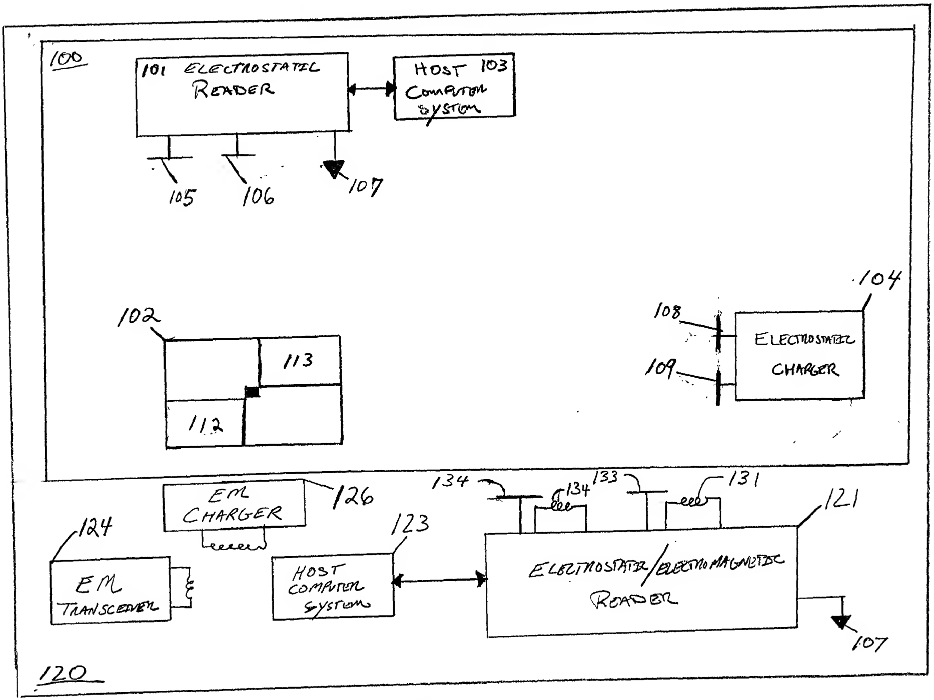

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sh. 1 of 16

FIG. 1

IND10200

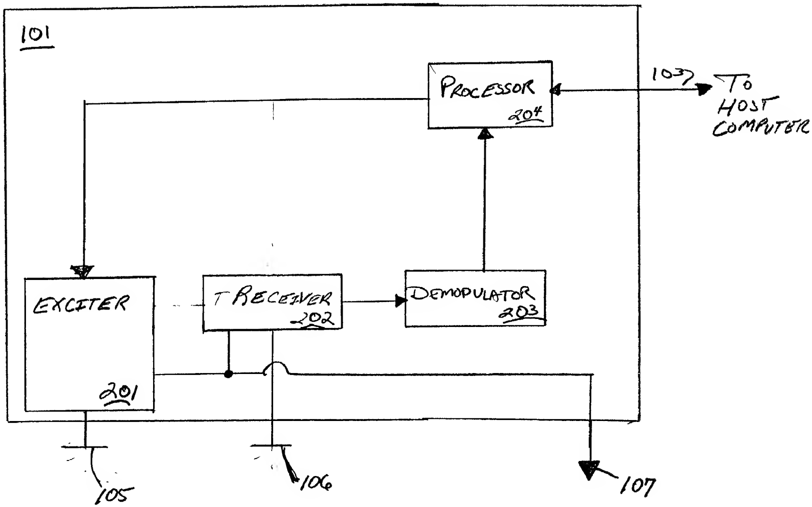

FIG. 2A

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sh. 2 of 16

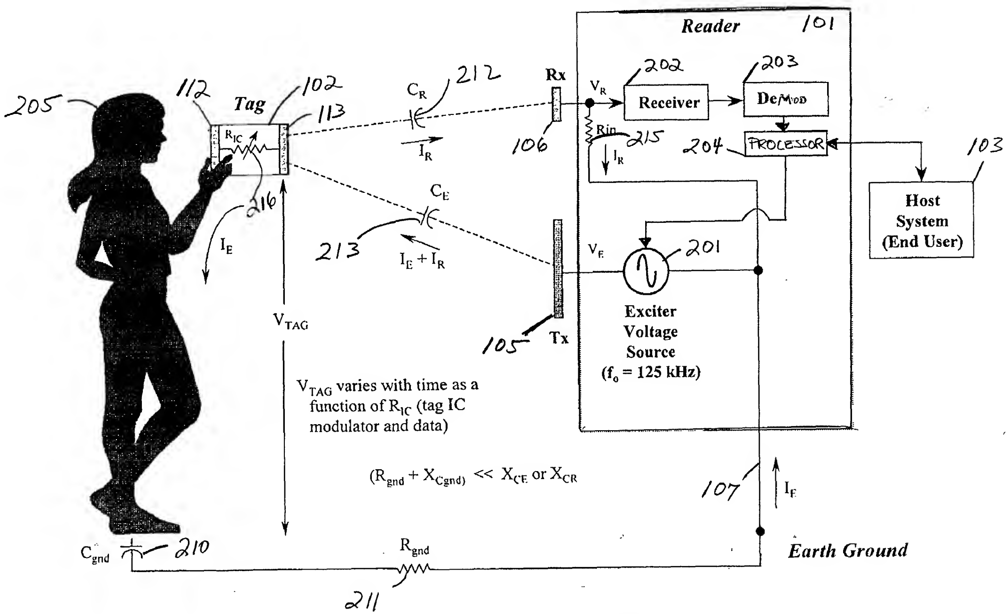

FIG. 2B

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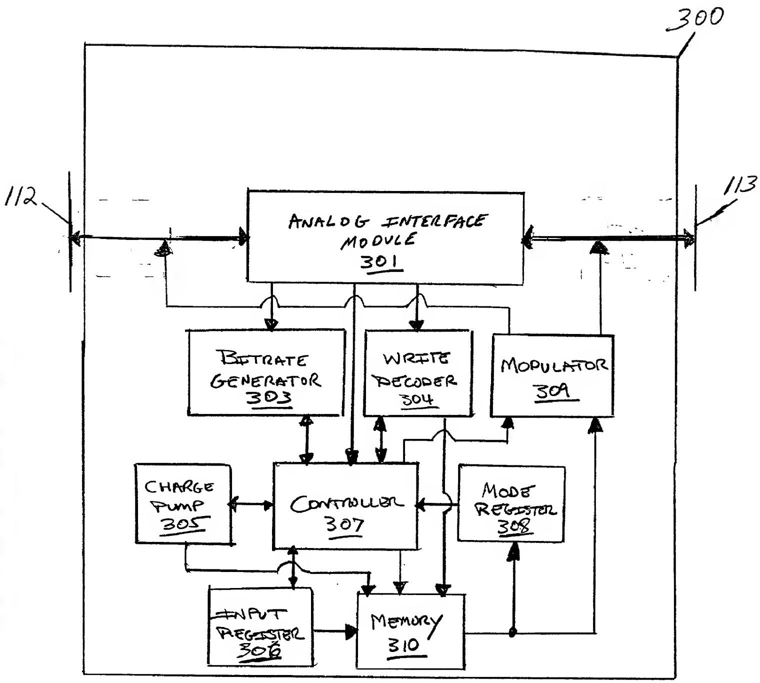
Sh. 3 of 16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112
113
ANALOG INTERFACE MODULE 301
BITRATE GENERATOR 303
WRITE DECODER 304
MODULATOR 309
CHARGE PUMP 305
CONTROLLER 307
MODE REGISTER 308
INPUT REGISTER 306
MEMORY 310

FIG. 3

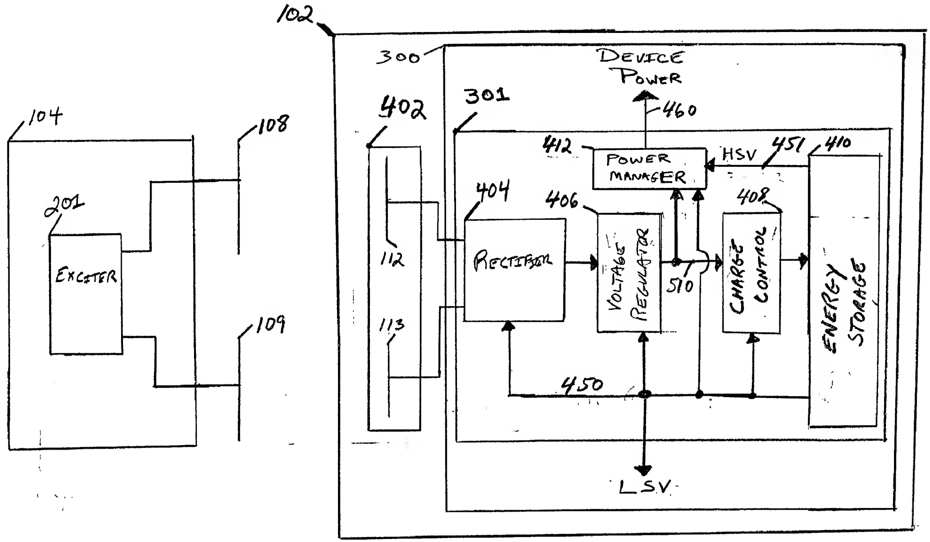

Fig. 4

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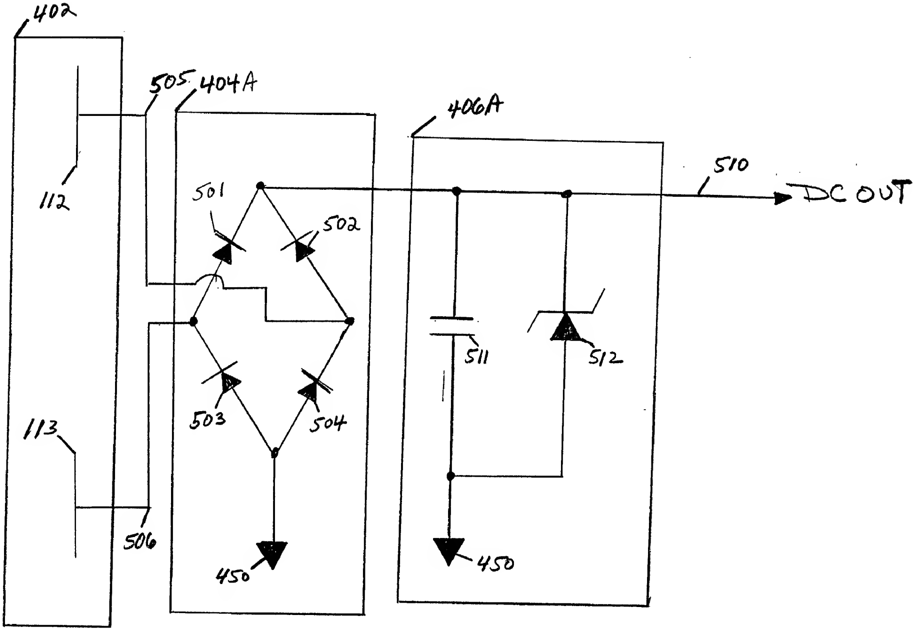

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Sh. 6 of 16

FIG. 5A

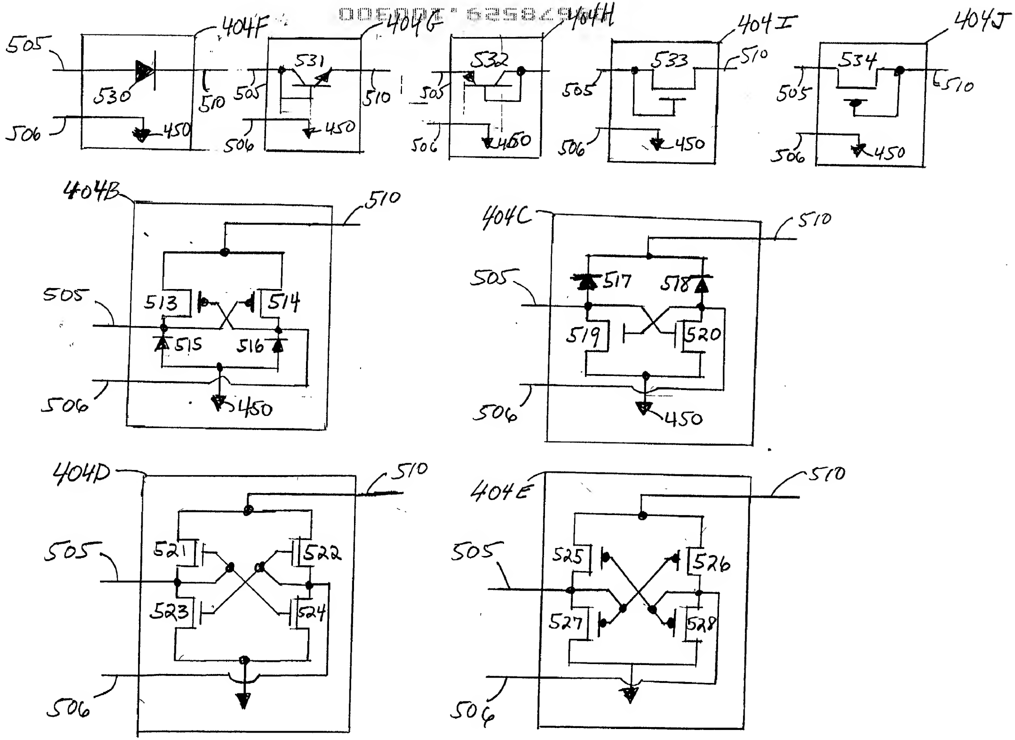
404F
404G
404H
404I
404J
404B
404C
404D
404E
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FIG. 5B

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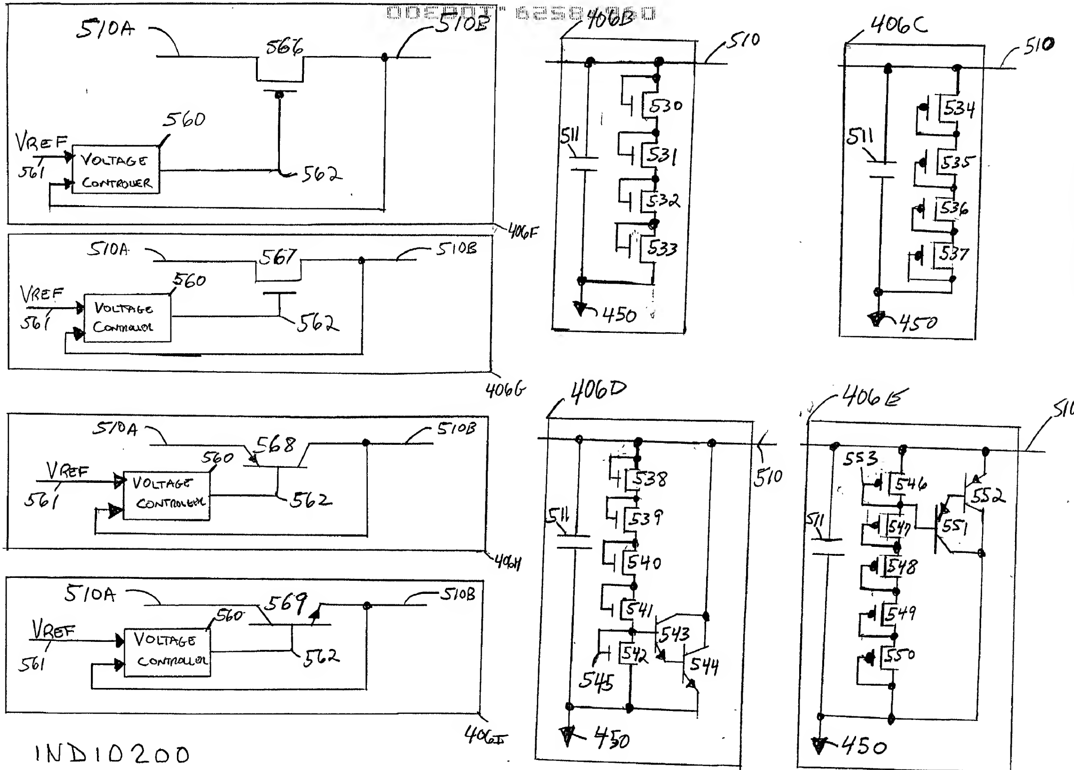

FIG. 5C

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sh. 8 of 16

IND10200

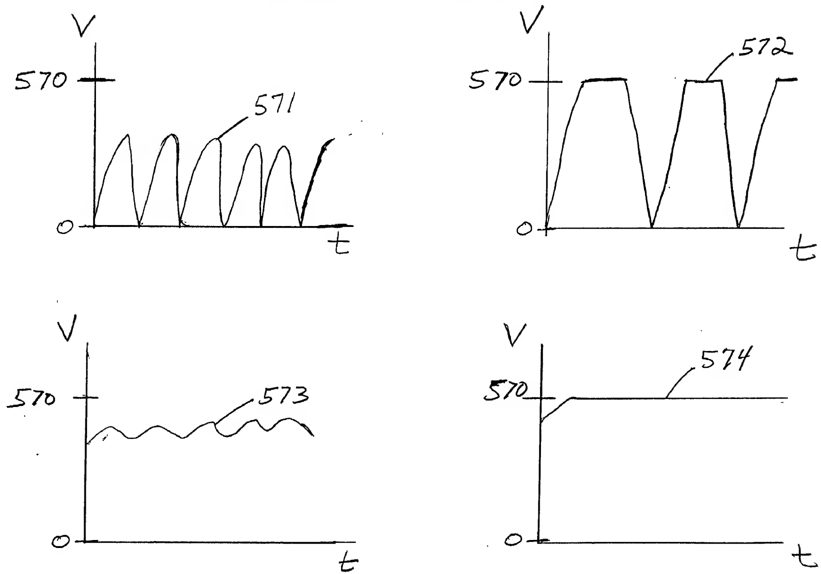

FIG. 5D

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sh. 9 of 16

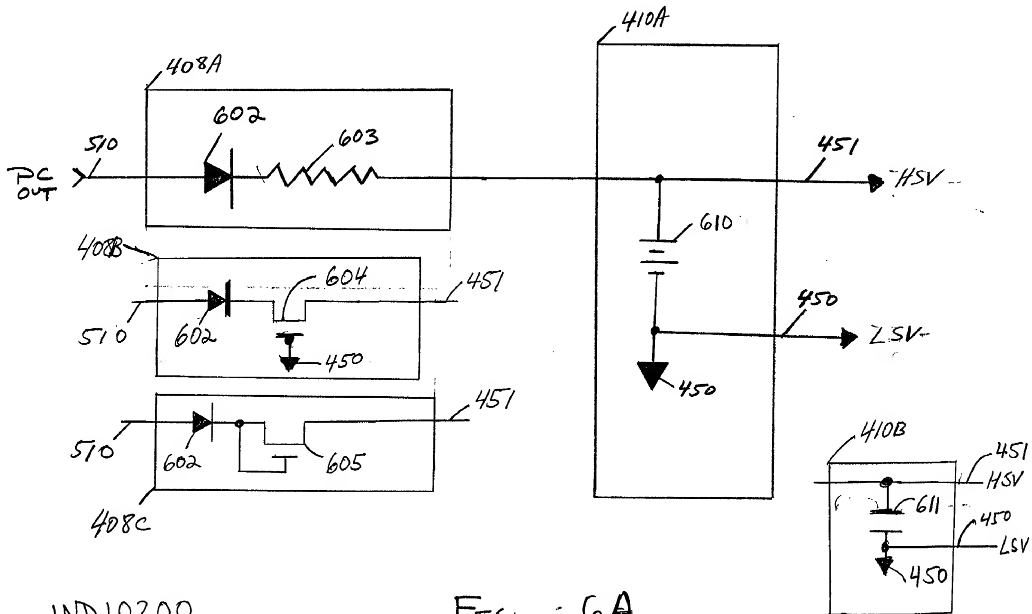

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FIG. 6A

IND 10200

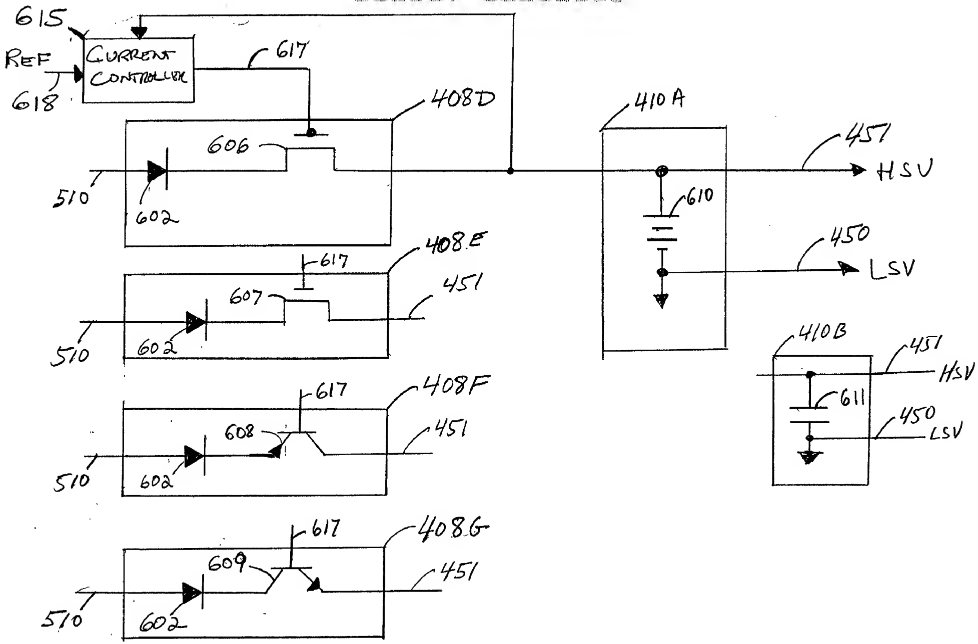

FIG. 6B

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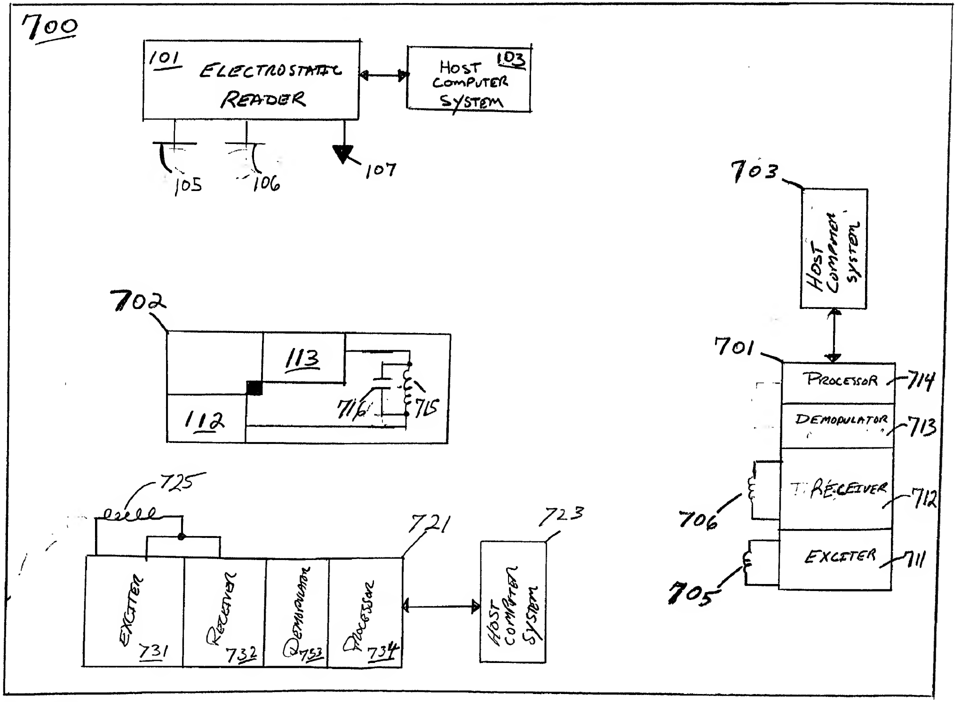

FIG. 7

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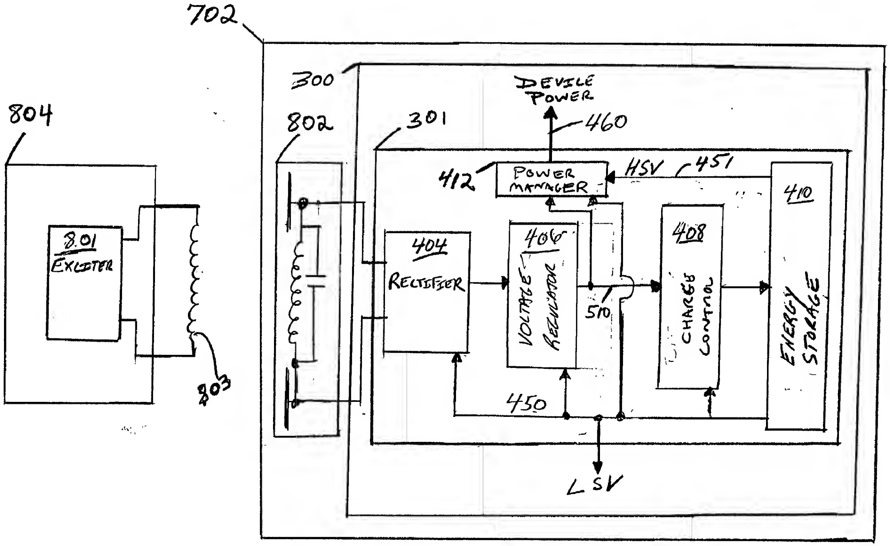

FIG. 8A

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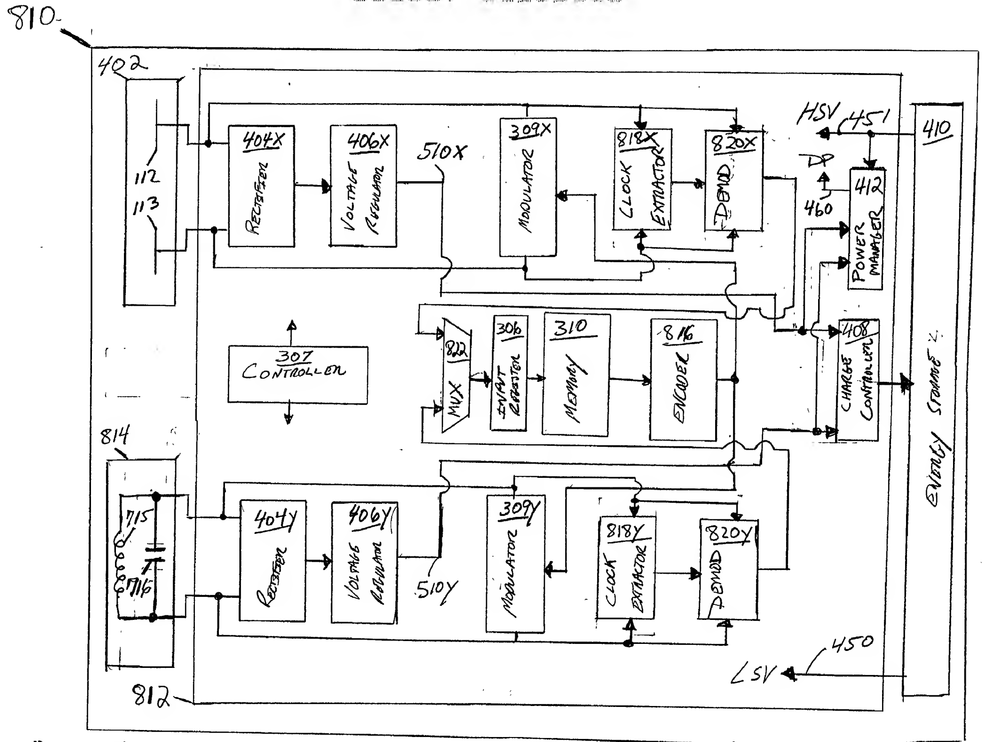

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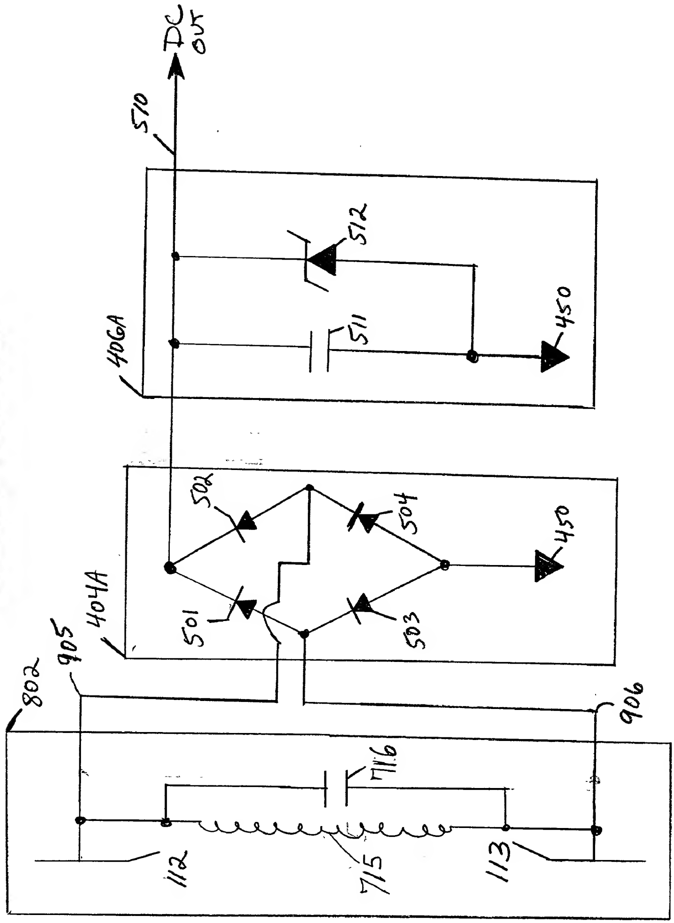
FIG. 8B


DC OUT
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406A
502
504
450
404A
501
503
905
802
906
716
112
715
113

FIG. 9

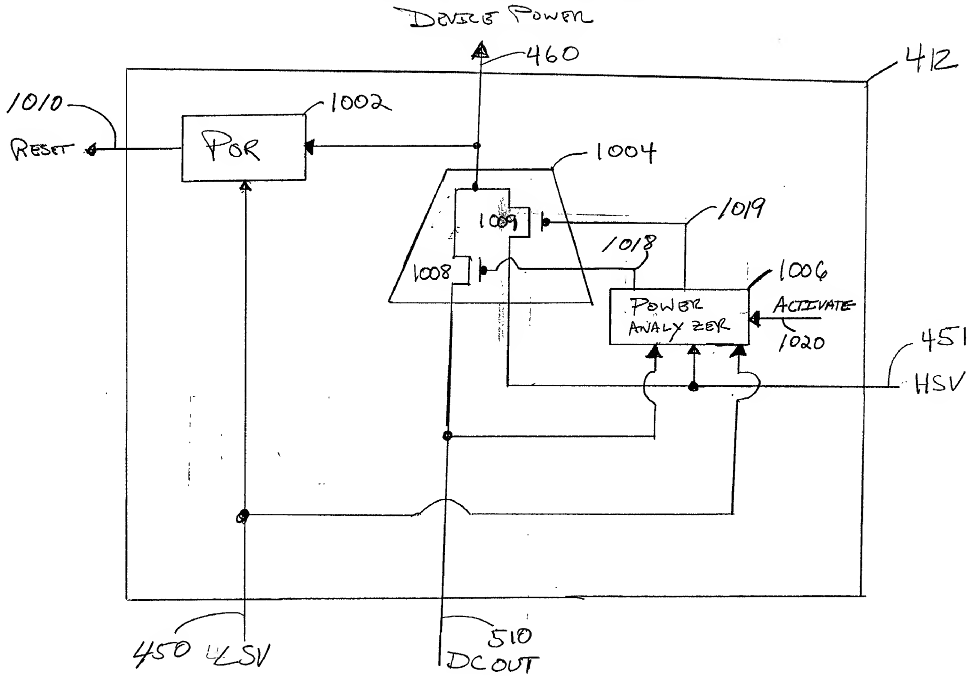

FIG. 10

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IND 10200

PATENT APPLICATION DECLARATION COMBINED
WITH POWER OF ATTORNEY

_X_ REGULAR (UTILITY) OR ___ DESIGN APPLICATION
(check one)

Attorney Docket
No. IND10200

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: "WIRELESS ELECTROSTATIC CHARGING AND COMMUNICATING SYSTEM", the specification of which:

(check one)

_X_ is attached hereto.

____ was filed on ________________ as U.S. Application Serial No. __________ and was amended on ____________.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

(check one)

_X_ no such applications filed.

____ such applications identified as follows:

			Priority Claimed	
(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No
(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No
(Serial No.)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the priority benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which is material to the examination of this application and which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S. Applications(s):
(check one)

____ no such applications filed.

_X_ such applications identified as follows:

"Express Mail" EL034004770US

Date of Deposit October 3, 2000

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Tammy A. Olson
Name of person mailing paper or fee
Tammy A. Olson 10-3-00

prior application by Theodore D. Geiszler et al., "Remotely powered electronic tag with plural electrostatic antennas and associated exciter/reader and related method; radio frequency identification tag system using tags arranged for coupling to ground; radio frequency identification tag arranged for magnetically storing tag state information; and radio frequency identification tag with a programmable circuit state," application number 09/061,146, filed 16 April 1998, attorney docket number IND00701P01, now pending.

I hereby declare that: as to any claimed subject matter of this application which is common to my earlier United States or foreign application(s), if any, which I have identified above and claimed the benefit of priority thereof, I do not believe that the same was ever known or used in the United States before my invention thereof or patented or described in any printed publication in any country before my invention thereof or more than one year prior to the first of said earlier application(s), or in public use or on sale in the United States more than one year prior to the first of said earlier application(s), and that the said common subject matter has not been patented or made the subject of an inventor's certificate before the date of the first of said earlier U.S. application(s) in any country foreign to the United States on an application, filed by me or my legal representatives or assigns more than twelve months (six months if the present application is a Design patent application) prior to the first of said earlier U.S. application(s), if any; and that, as to any claimed subject matter of this application which is not common to said earlier application(s), if any, I do not know and do not believe that the same was ever known or used in the United States before my invention thereof or patented or described in any printed publication in any country before my invention thereof or more than one year prior to the date of this application, or in public use or on sale in the United States more than one year prior to the date of this application, and that said subject matter has not been patented or made the subject of an inventor's certificate in any country foreign to the United States on an application filed by me or my legal representatives or assigns more than twelve months (six months if the present application is a Design patent application) prior to the date of this application.

I HEREBY APPOINT THE FOLLOWING AS MY ATTORNEY(S) OR AGENT(S) WITH FULL POWER OF SUBSTITUTION TO PROSECUTE THIS APPLICATION AND TRANSACT ALL BUSINESS IN THE PATENT AND TRADEMARK OFFICE CONNECTED THEREWITH:

NAME(S)	REGISTRATION NO.(S)	ASSOCIATE POWER OF ATTORNEY ATTACHED
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Val Jean Hillman	34,841	
Wayne J. Egan	33,168	
Jonathan P. Meyer	30,477	
Susan L. Lukasik	35,261	
George C. Pappas	35,065	___ Yes X No

09587.00 "0.6 0.0.1.0 (margin stamp)

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Schaumburg, IL 60196

Direct Telephone Calls to: (847) 576-0860

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statement and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature: Victor Vega

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Inventor's signature: John Rolin

Date: 17 Dec., 1998

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"Express Mail" EE 542827207US

Date of Deposit 1-5-99

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Tanya Zeller
Name of person mailing paper or fee

Signature 1/5/99 Date